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NSWCDD/TR-98/7

USER'S GUIDE FOR AN INTERACTIVE PERSONAL COMPUTER INTERFACE FOR THE 1998 AEROPREDICTION CODE (AP98)

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13. ABSTRACT (Maximum 200 words)

This report describes interactive, user-friendly, preprocessing and post-processing personal computer (P.C.) modules designed to operate with the latest version of the Naval Surface Warfare Center (NSWC) Aeroprediction Code (AP98). As part of the preprocessing input module, geometry inputs are automated by giving the user many options. By using this new software, a set of aerodynamic coefficients can be obtained on most weapon configurations in less than 15 minutes from time of initial setup to computer outputs, compared to 2 to 4 hours for the AP98 computer mainframe version. While the computer cost savings are modest (the AP98 executes on a large computer in less than a second), the manpower savings and productivity enhancements can be significant. Various plots of the aerodynamic coefficients are available to the user and are plotted automatically by the post-processing module. Data output is also made available to the user in the form of standard Aeroprediction output files as well as tabulated data.

The User's Guide is designed to aid users of the AP98 by correlating AP98 P.C. Interface Data Inputs and the corresponding source-code variable names. This cross-referencing information is given in italics in the discussion.

14. SUBJECT TERMS

Aeroprediction Code, AP98, standard keyboard, mouse, menu bar, menu pads, user interface, data field, flight configuration, nose geometry, airfoil, centroid, boattail/flare

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FOREWORD

The work described in this report was undertaken because of several upgrades that have been made to the Naval Surface Warfare Center (NSWC) 1995 Aeroprediction Code (AP95). These improvements to the AP95 gave rise to additional data inputs that the user is required to supply. As a result, the AP95 Computer Interface has been modified to accommodate these new inputs. This User's Guide describes an interactive preprocessing package for inputs to the 1998 Aeroprediction Code (AP98), which allows a configuration to be much more easily set up for computations compared to the computer mainframe version of the AP98. The User's Guide then gives options for post-processing of data in a limited number of plots.

As noted on the cover page, Cornell Downs of Tracor was involved in the development of this user's guide. The work described in this report was supported through the Office of Naval Research (Mr. Dave Siegel) by the following programs: the Air Launched Weapons Program managed at the Naval Air Warfare Center, China Lake, CA, by Mr. Tom Loftus and Dr. Craig Porter, and the Surface Weapons Systems Technology Program managed at the Naval Surface Warfare Center, Dahlgren Division (NSWCDD) by Mr. Robin Staton and Mr. Gil Graff. Also, support was provided by the Marine Corps Weaponry Technology Program managed at NSWCDD by Mr. Bob Stiegler. The authors express appreciation for support received in this work.

This report has been reviewed and approved by Dr. Tom Rice of the Aeromechanics Branch and Mr. Keith Miller of the Missile Systems Division.

Approved by:

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CHAPTER 1

INSTALLING THE AP98 INTERFACE

1.1 AP98 INTERFACE SYSTEM REQUIREMENTS

The following system environment is required to run the Naval Surface Warfare Center (NSWC) Aeroprediction Code (AP98) Interface program:

- Processor: 386SX or higher (Note: the AP98 Interface will not run on a Windows NT machine.)
- Math Co-processor: Intel 80x87
- Random Access Memory (RAM): 3 MB
- Available Hard Disk Space: 20 MB
- CD ROM Drive
- MS-DOS Version: 3.1 or higher
- Mouse: Recommended but not necessary
- Terminate-Stay-Resident (TSR) Routines Activated: None

1.2 INSTALLATION PROCEDURES

1.2.1 Installation from DOS Prompt

To install the AP98 Interface from the DOS prompt:

1. Create a directory on the hard drive to install the AP98 Interface (i.e., type **mkdir *AP98*** at the **C:** prompt and then press **enter**).
2. Make the created directory the current directory (i.e., type **cd *AP98*** at the **C:** prompt and then press **enter**).

3. Insert the CD into the CD ROM drive.

4. Copy all files from the CD into the AP98 directory (i.e., if the CD ROM device is drive F, then type **copy f:*.* *.*** and then press **enter**).

5. Remove the read-only attribute from all of the files by typing **attrib *.* -r** and then pressing **enter**.

6. Modify the FILES statement in the CONFIG.SYS so that the files setting is 40 or more (i.e., edit the CONFIG.SYS file, making sure that the FILES statement is set to at least 40).

1.2.2 Instructions for Setting up Access to the AP98 Program Using Windows 95

To create a shortcut on the desktop for AP98:

1. Using Windows Explorer, click on the CD ROM icon to display its contents.

2. Drag the AP98 folder from the right window pane over to the C: drive. (This will automatically create a directory called C:\AP98 and copy all necessary files into it.)

3. Click on the newly created C:\AP98 folder (in the left-hand window pane).

4. Click on the Edit menu to reveal the "select all" option. Click on the "select all" option.

5. Click on the File menu to reveal the "properties" option. Click on the "properties" option. This will open a window that contains an attributes section. Upon entering the window, a check mark will appear in the "read-only" selection box. Click in this box to remove the check mark. Click on the "ok" button.

6. Using Windows Explorer, locate the file "AP98.BAT" in the AP98 directory.

7. Using the right mouse button, drag this file to an open area of the Windows 95 desktop.

8. When the mouse button is released, a menu will automatically come up. Choose "Create Shortcut Here" from the menu.

9. Press the "F2" key while the shortcut icon is highlighted to rename the shortcut.

To add AP98 to the start menu (in the programs sub-menu):

1. Using Windows Explorer, click on the CD ROM icon to display its contents.

2. Drag the AP98 folder from the right window pane over to the C: drive. (This will automatically create a directory called C:\AP98 and copy all necessary files into it.)

3. Using Windows Explorer, locate the file "AP98.BAT" in the AP98 directory.

4. In the left pane of the Explorer window, expand the "Windows" folder to reveal the folders within the "Windows" folder. Expand the folder called "Start Menu" to reveal its sub-folders.

5. Using the right mouse button, drag the "AP98.BAT" file from the right pane to the folder called "Programs" in the "Start Menu" folder.

6. When the mouse button is released, a menu will automatically come up. Choose "Create Shortcut Here" from the menu.

7. To rename the shortcut, select the "Programs" folder to display its contents. Select the newly created shortcut and then press the "F2" key to rename it.

1.3 STARTING THE AP98 INTERFACE

To start the AP98 Interface from the MS-DOS prompt, the current directory must be the directory that contains the AP98 Interface files. When in the correct directory, type **AP98** and then press **Enter**. Upon entering AP98 at the MS-DOS prompt, the AP98 Interface startup screen will appear. Figure 1 shows the AP98 Interface startup screen. To start the AP98 Interface from the Windows 95 environment, double click on either the AP98 icon or the appropriate program under the Start Menu\Programs sub menu.

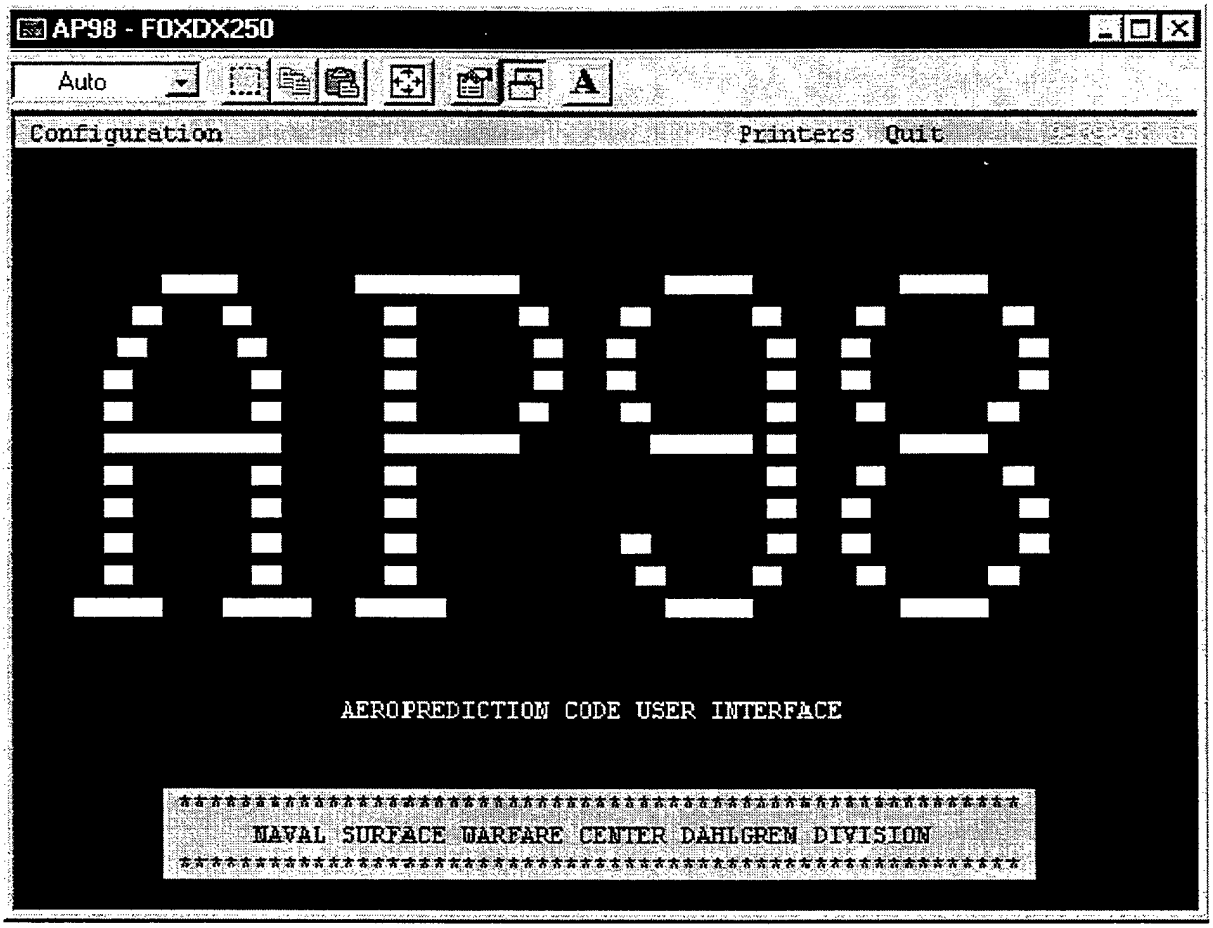


FIGURE 1. AP98 INTERFACE STARTUP SCREEN

CHAPTER 2

INTERFACE BASICS

The AP98 Interface consists of menus, data entry screens, and other features that make it easy for the user to communicate with AP98.

The AP98 Interface is designed for use with a mouse or a standard keyboard. With a keyboard, the arrow keys and keystroke combinations are used to enter data or to choose objects and controls in the interface. Although not required, a mouse is recommended for its ease-of-use. With the click of a button, a mouse can accomplish the equivalent of a single keystroke or many keystrokes on the keyboard.

This chapter is divided so that keyboard users can refer to the "Keyboard Techniques" section and mouse users can refer to the "Mouse Techniques" section. Mouse users who wish to use the keyboard for certain activities may want to read the "Keyboard Techniques" section also.

2.1 KEYBOARD TECHNIQUES

2.1.1 Using Menus with the Keyboard

The AP98 Interface menu system consists of the following parts: menu bar, menu pads, menu popups and menu options. Each part of the menu system is displayed in Figure 2.

2.1.1.1 Menu Bar

The menu bar is located along the top of the AP98 Interface title screen. The *menu bar* displays names for menu popups. These names on the menu bar are called *menu pads*. The content of the menu bar changes as the user accesses different parts of the interface. Different actions cause menu pads to be added to and removed from the menu bar.

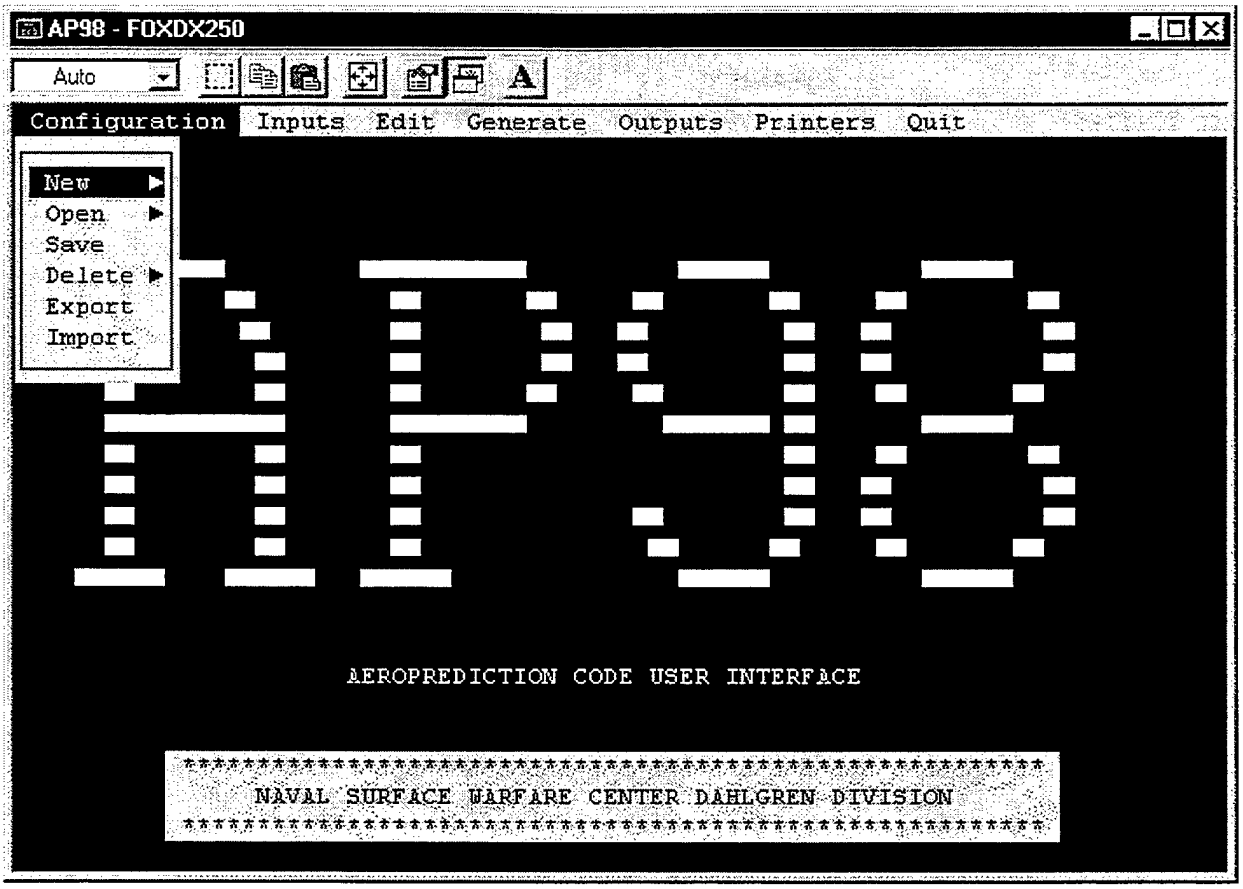


FIGURE 2. AP98 INTERFACE MENU SYSTEM

2.1.1.2 Menu Pads

Menu pads appear on the menu bar and display either the name of a menu popup, a data entry screen, or an action to be taken. The keyboard can be used to display the menu popup or data entry screen, or cause the action associated with each menu pad. Certain menu pads may be invisible and cannot be chosen. These menu pads are *disabled.*

To access the menu bar, press the Alt key. The **Configuration** menu pad appears highlighted because it is selected. Press the Right and Left Arrow keys to move from menu pad to menu pad. To choose a menu pad selection, press the Enter key. An alternate method of choosing a menu pad selection is to press the hot key in the menu pad name. The *hot key* is highlighted and is usually the first letter in the menu pad name.

2.1.1.3 Menu Popups

Some menu pads control menu popups. *Menu popups* are lists of related options. When you choose an option from a menu popup, you are telling the AP98 Interface what action to take. *Choose* means to activate a *selection* (highlighted option) by pressing the Enter key.

Once a menu popup is displayed, you will usually choose an available option, as described in the next section. If you wish to deactivate a menu popup without choosing an option, press the Alt key.

2.1.1.4 Menu Options

Menu popups contain *options*. The options on each menu popup are logically related to the controlling menu pad. On a single menu popup, options may be further grouped to indicate that they produce similar outcomes. These groups are separated by divider lines. Certain menu options are followed by an arrow pointing to the right. When you choose this type of option, another menu popup appears with a different set of options. Sometimes a menu option will be invisible and cannot be chosen. This menu option is disabled.

Once a menu popup appears, an option can be chosen in one of the following ways:

- Press the hot key for the option.
- Use the Up and Down Arrow keys to select the desired option, then press the Enter key.

When you choose a menu option, a menu popup or data entry screen may appear, or an action may occur.

2.1.2 Using Data Entry Screens with the Keyboard

When you choose certain menu pads or menu popup options, a data entry screen will appear. Data entry screens contain fields to enter data and a variety of controls that are used to designate, confirm, or cancel actions. The fields and controls are explained in the next few paragraphs. In addition, methods of moving in data entry screens will also be explained. Figure 3 is an example of an AP98 Interface data entry screen.

2.1.2.1 Data Fields

In the data entry screen, data item descriptions consist of descriptive text followed by a colon. In most cases, the data item description is immediately followed by an associated data field. The *data field* is a rectangular area designated for the display of specific related data from the AP98 Interface or the entry of corresponding data by the user. The AP98 Interface interprets a blank numeric data field as zero, and a blank character data field as null. To select a data field, press the Tab key until the desired data field is highlighted. To enter data, type in a response and press the Enter key. In the cases where the data field requires numeric data, a message is displayed at the bottom of the data entry screen informing the user of the required units and the data entry format.

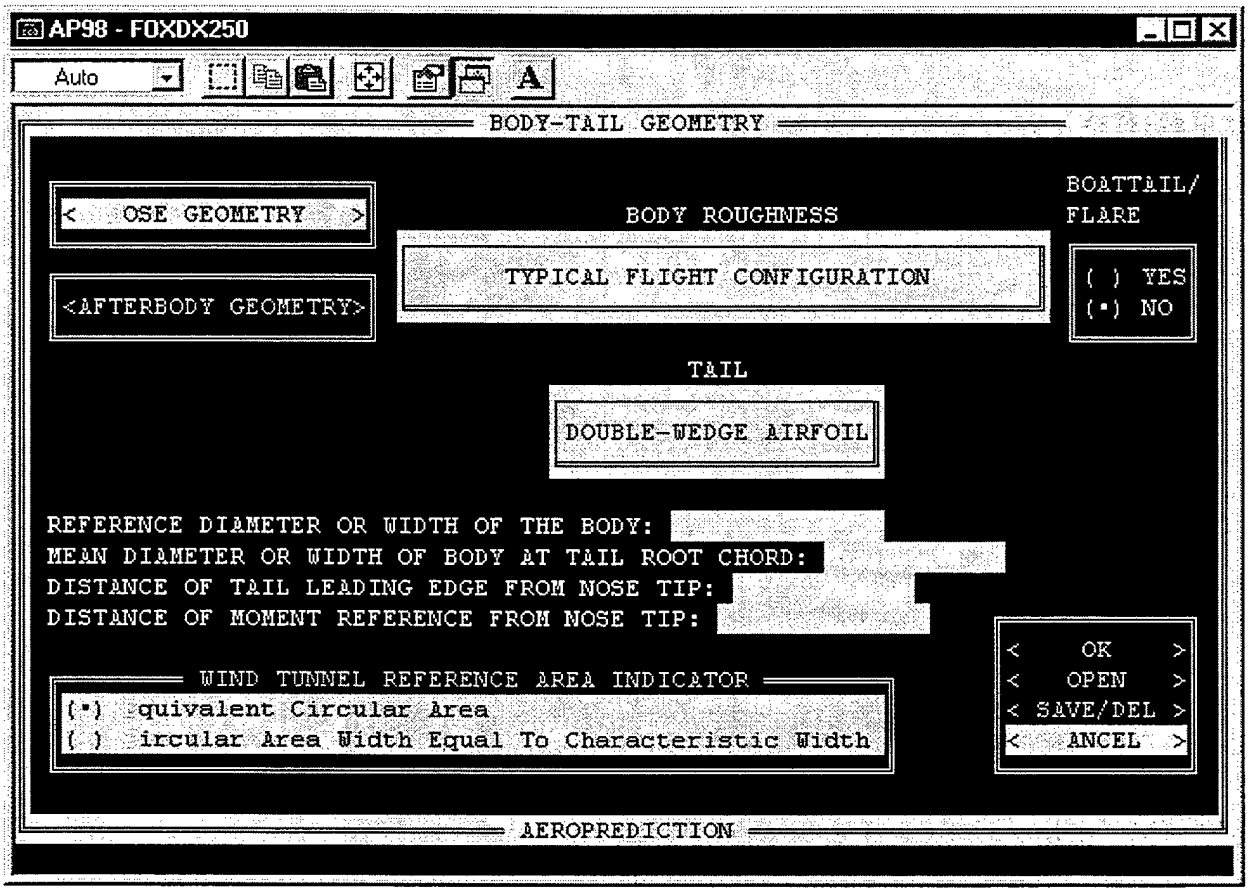


FIGURE 3. EXAMPLE OF AP98 INTERFACE DATA ENTRY SCREEN

2.1.2.2 Pushbutton

A *pushbutton* is enclosed in angle brackets and contains key words that describe the action it triggers. The action associated with a pushbutton occurs immediately. The action specified may result in the completion or cancellation of the data entry process, or it may cause another data entry screen to be displayed. To select a pushbutton, press the Tab key until the desired pushbutton is highlighted. To choose a selected pushbutton, press the Enter key.

2.1.2.3 Radio Button

A *radio button* is a set of parentheses followed by text. Radio buttons are situated as groups of related items. Only one radio button in a group can be chosen at any given time. To select a radio button, press the Tab key until the desired radio button is highlighted. To choose a selected radio button, press the Enter key. When a radio button is chosen, a bullet appears in the parentheses and any previously chosen radio button in the group becomes deselected. In the AP98 Interface data entry screens, all radio button groups have a radio button that is chosen as a default.

2.1.2.4 Popup Control

The rectangle with double lines on the right and bottom edges (see Figure 3) is a *popup control* that you can choose to display the associated popup. To select a popup control, press the Tab key until the desired popup control is highlighted. To choose a selected popup control and display the associated popup, press the Enter key. When the popup is displayed, use the PgDn and PgUp keys to scroll the list one full window at a time. Use the Home and End keys to move to the first or last option on the popup. To choose a popup option, press the Up and Down Arrow keys to select the option, then press the Enter key. In some popups, the popup options are listed in alphabetical order. To move directly to an option on an alphabetized popup, type enough letters to uniquely identify the option. The letters you type don't appear on the screen. When the appropriate option is selected, press the Enter key.

The action associated with a popup option may cause another data entry screen to be displayed or may result in unseen internal data processing. In either case, the user's most recent selection will be displayed in the popup control rectangle. In AP98 Interface data entry screens, the first popup option is chosen as a default. Figure 4 shows the AP98 Interface data entry screen depicted in Figure 3 with a popup control chosen and its associated popup options displayed.

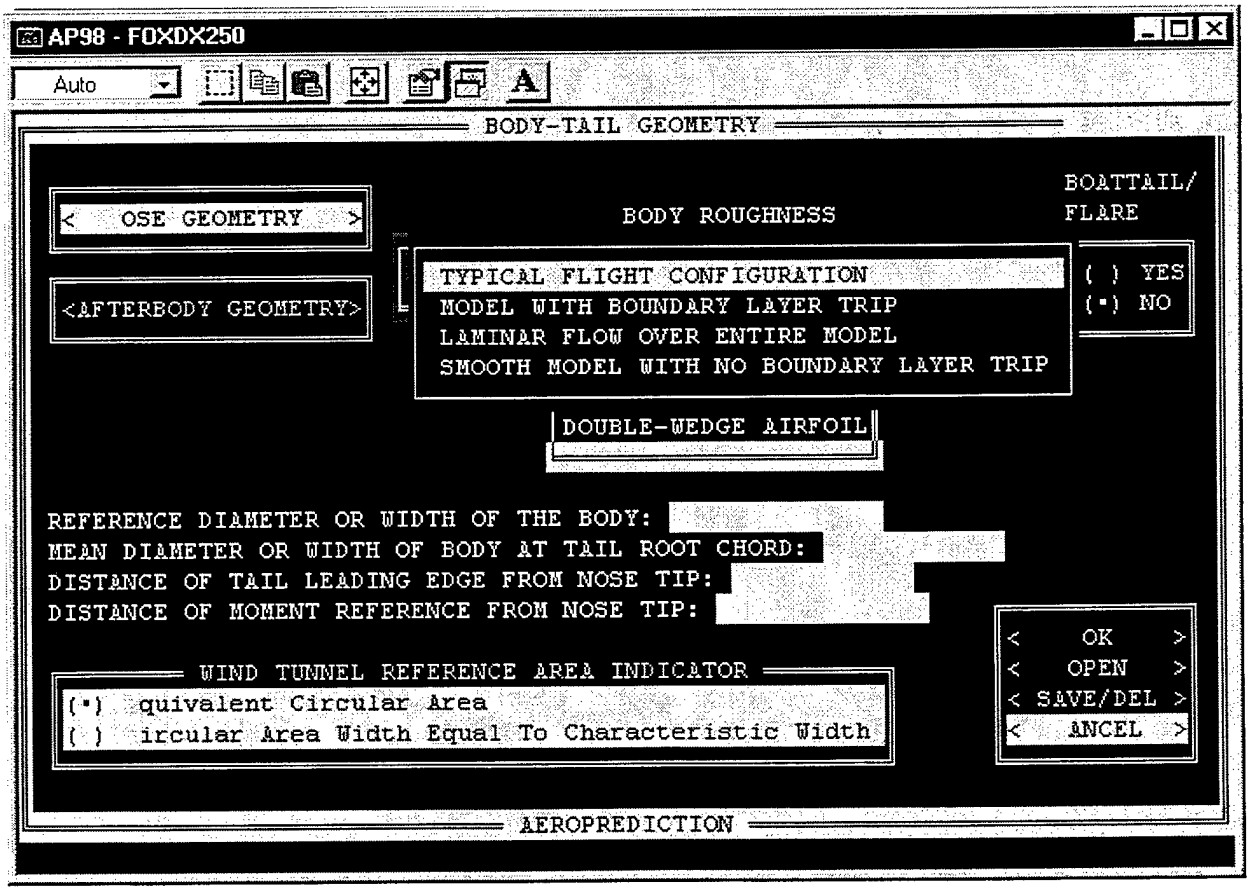


FIGURE 4. EXAMPLE OF AP98 INTERFACE DATA ENTRY SCREEN WITH POPUP CONTROL ACTIVATED

2.1.2.5 List

A *list* is simply a box containing a list of items. When using the keyboard, a list is similar to the popup options, except that a list is always displayed. Figure 5 is an example of an AP98 Interface data entry screen that contains a list.

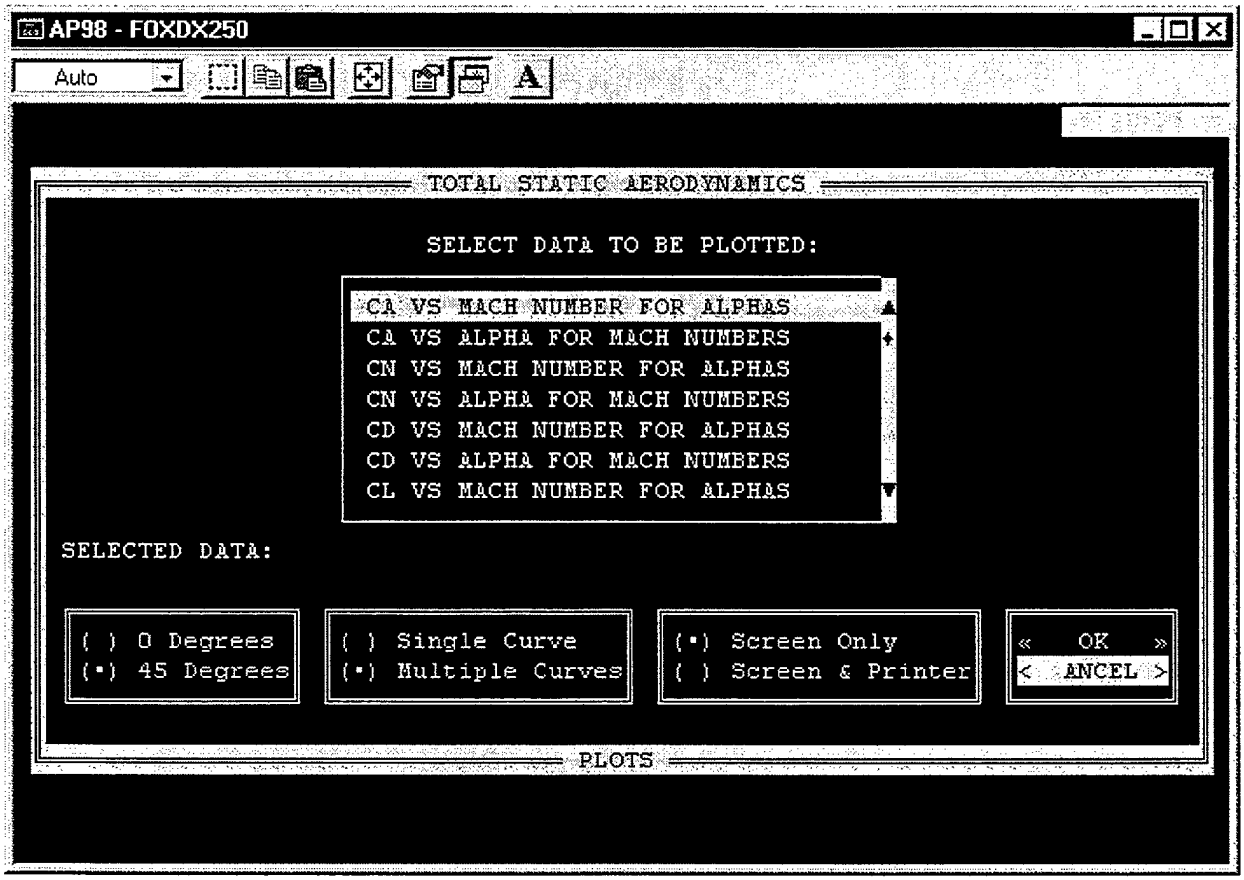


FIGURE 5. EXAMPLE OF AP98 INTERFACE DATA ENTRY SCREEN CONTAINING A LIST

2.1.3 Movement in Data Entry Screens with the Keyboard

In a data entry screen, movement flows from top to bottom and left to right. The following keys allow you to maneuver in data entry screens with the keyboard:

Tab—Selects the next data field or data entry screen control.

Shift+Tab—Selects the previous data field or data entry screen control.

Up/Down Arrows—When in a list or popup control, the Up/Down Arrows move up and down through the list or popup options, item-by-item.

Home and **End**—When in a list or popup control, Home and End select the first and last item in the list or popup option.

PgUp and **PgDn**—When in a list or popup control, PgUp and PgDn display the previous or next window in the list or popup control.

Enter—When in a data field, pushbutton, radio button, popup control, or list, Enter selects the next data field or data entry screen control once all associated processing for the current data field or data entry screen control has been completed.

2.2 MOUSE TECHNIQUES

It is particularly convenient to operate the AP98 Interface with a mouse. To do this, a mouse driver must be loaded and a mouse must be attached to the computer. When you complete these steps and start the AP98 Interface, a pointer will appear on your screen.

The *pointer* is a solid box that contrasts with whatever it rests upon. When you roll the mouse, the pointer moves. You can position the pointer and *click* (press and release the mouse button) to anchor the pointer. The pointer marks the location where an action will occur. Note that the left button on your mouse is the only one required by the AP98 Interface.

2.2.1 Using Menus with the Mouse

The AP98 Interface menu system consists of the following parts: menu bar, menu pads, menu popups and menu options. Each part of the menu system is displayed in Figure 2 on page 5.

2.2.1.1 Menu Bar

The menu bar is located along the top of the AP98 Interface title screen. The *menu bar* displays names for menu popups. These names on the menu bar are called *menu pads*. The content of the menu bar changes as you access different parts of the interface. Different actions cause menu pads to be added to and removed from the menu bar.

2.2.1.2 Menu Pads

Menu pads appear on the menu bar and either display the name of a menu popup, a data entry screen, or an action to be taken. The mouse can be used to display the menu popup or data entry screen, or cause the action associated with each menu pad. Certain menu pads may be invisible and cannot be chosen. These menu pads are *disabled.*

To access a menu pad, point to the desired pad and click.

2.2.1.3 Menu Popups

Some menu pads control menu popups. *Menu popups* are lists of related options. A menu popup will be displayed when you choose a menu pad that controls a menu popup. *Choose* means to activate a *selection* by pointing to it and clicking.

To display a menu popup, you will have to point to a menu pad that controls a menu popup and click the mouse button. Once a menu popup is displayed, you will usually choose an available option, as described in the next section. The menu popup will remain on the screen until you choose a menu option or click anywhere off of the menu popup. By clicking anywhere off of the menu popup, you are essentially deactivating the menu popup without choosing an option.

2.2.1.4 Menu Options

Menu popups contain *options*. The options on each menu popup are logically related to the controlling menu pad. On a single menu popup, options may be further grouped to indicate that they produce similar outcomes. These groups are separated by divider lines. Certain menu options are followed by an arrow pointing to the right. When you choose this type of option, another menu popup appears with a different set of options. Sometimes a menu option will be invisible and cannot be chosen. This menu option is disabled.

Once a menu popup is displayed, an option can be chosen by pointing to the desired option and clicking. When you choose a menu option, a menu popup or data entry screen may appear, or an action may occur.

2.2.2 Using Data Entry Screens with the Mouse

When you choose certain menu pads or menu popup options, a data entry screen will appear. Data entry screens contain blank data fields and a variety of controls that are used to designate, confirm, or cancel actions. The fields and controls are explained in the next few paragraphs. Using the mouse, you can move in data entry screens by positioning the pointer, selecting, and clicking the mouse button to choose. Figure 3 on page 7 is an example of an AP98 Interface data entry screen.

2.2.2.1 Data Fields

In the data entry screen, data item descriptions consist of descriptive text followed by a colon. In most cases, the data item description is immediately followed by an associated data

field. The *data field* is a rectangular area designated for the display of specific related data from the AP98 Interface or the entry of corresponding data by the user. The AP98 Interface interprets a blank numeric data field as zero, and a blank character data field as null. To select a data field, point and click on the desired field. To enter data, type in a response and press the Enter key. In the cases where the data field requires numeric data, a message is displayed at the bottom of the data entry screen informing the user of the required units and the data entry format.

2.2.2.2 Pushbutton

A *pushbutton* is enclosed in angle brackets and contains key words that describe the action it triggers. The action associated with a pushbutton occurs immediately. The action specified may result in the completion or cancellation of the data entry process, or it may cause another data entry screen to be displayed. To choose a pushbutton, point and click on the desired pushbutton.

2.2.2.3 Radio Button

A *radio button* is a set of parentheses followed by text. Radio buttons are situated as groups of related items. Only one radio button in a group can be chosen at any given time. To choose a radio button, point and click on the desired radio button. When a radio button is chosen, a bullet appears in the parentheses and any previously chosen radio button in the group becomes deselected. In the AP98 Interface data entry screens, all radio button groups have a radio button that is chosen as a default.

2.2.2.4 Popup Control

The rectangle with double lines on the right and bottom edges (see Figure 3) is a *popup control* that you can choose to display the associated popup. To choose a selected popup control and display the associated popup, point and click on the desired popup control without releasing the mouse button. To choose a popup option, drag the mouse (i.e., move the mouse backwards or forward while still pressing the mouse button) until the desired option is highlighted; then release the mouse button.

The action associated with a popup option may cause another data entry screen to be displayed or may result in unseen internal data processing. In either case, the user's most recent selection will be displayed in the popup control rectangle. In the AP98 Interface data entry screens, the first popup option is chosen as a default. Figure 4 on page 8 shows an AP98 Interface data entry screen with a popup control chosen and its associated popup options displayed.

2.2.2.5 List

A *list* is simply a box containing a list of items. When a list is so long that all of the items cannot be displayed, a scroll bar will appear along the right edge of the box. Click the arrows at either end of the scroll bar to move through the contents of the list little by little. Drag the diamond-shaped "thumb" to move through the list contents rapidly. The position of the thumb will indicate your position in the list. Click on the scroll bar above or below the thumb to move up one page or down one page. One of two methods can be used to choose a desired item:

1) Click on the desired item to select it, and then press the Enter key.

2) Double-click (i.e., rapidly press the mouse button two times) on the desired item.

Figure 5 on page 9 is an example of an AP98 Interface data entry screen that contains a list.

CHAPTER 3

THE AP98 INTERFACE

A new and improved version of the NSWCDD AP98 has been developed. The new code contains new technology that allows planar aerodynamics of axisymmetric solid-rocket-type weapons to be computed with engineering accuracy over the Mach number range of 0 to 20 and for angles of attack to 90 degrees. New technology developed and included in the AP98 code includes

- Improved axial force coefficient at angle of attack
- Nonlinear aerodynamic loads distributed over body and wings for structural engineers
- Ability to run in the roll orientation of both 0 and 45 degrees
- Ability to run bodies with non-circular cross sections

Comparison of the AP98 code to available computations of other state-of-the-art codes show the AP98 code to be as good as, or superior to, these codes for planar aerodynamics. For a more detailed discussion of the AP98 code, see References 1 and 2.

To improve the ease of use of the AP98 code, the AP98 Interface has been developed. The sections that follow provide a detailed description of the interface and the guidance necessary for its use.

The User's Guide is designed to aid users of the AP98 by correlating AP98 P.C. Interface Data Inputs and the corresponding source-code variable names. This cross-referencing information is given in italics in the discussion.

3.1 AP98 INTERFACE MENU

The AP98 Interface menu is the vehicle to use in order to gain access to the various features of the AP98 Interface.

3.1.1 AP98 Interface Menu Bar

The AP98 Interface menu bar, with all of the menu pads enabled, is depicted in Figure 2 on page 5. The AP98 Interface menu bar contains the following menu pads:

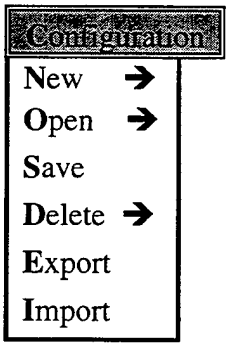
Configuration	Inputs	Edit	Generate	Outputs	Printers	Quit

Not all of the menu pads are enabled at program startup. Different actions will cause menu pads to be added to or removed from the menu bar.

3.1.2 AP98 Interface Menu Pads

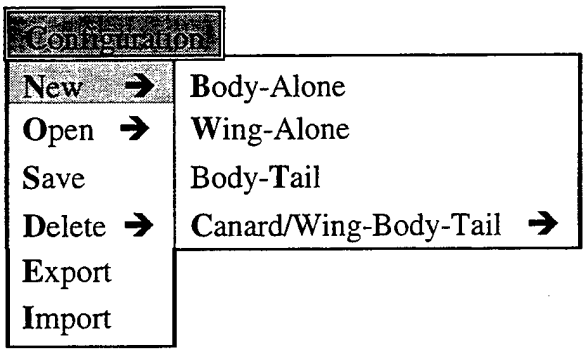
3.1.2.1 Configuration

The Configuration menu pad is enabled at program startup. It is the controlling menu pad for the Configuration menu popup. When you choose the Configuration menu pad, the Configuration menu popup is displayed. The Configuration menu popup contains the following menu options:



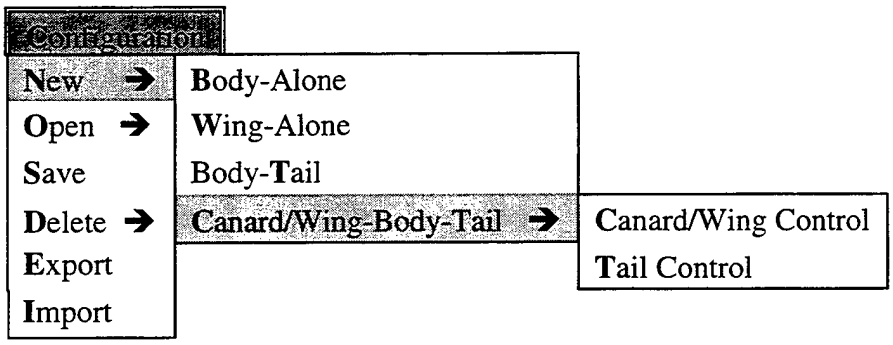
3.1.2.1.1 Configuration/New

The New menu option is always enabled. By choosing the New menu option, the user can begin the process of defining an aeroprediction configuration that can be processed by the AP98 code. Upon choosing the New menu option, a second-tier menu popup is displayed containing menu options for the following configuration types:



The choice of the Body-Alone, Wing-Alone, or Body-Tail second-tier menu options will result in the enabling of the Inputs menu pad (on the menu bar, page 15). You will need to choose the Inputs menu pad to access the various menu options available for creating an aeroprediction configuration file that defines the configuration type that you have chosen. The Inputs menu pad is discussed in Section 3.1.2.2.

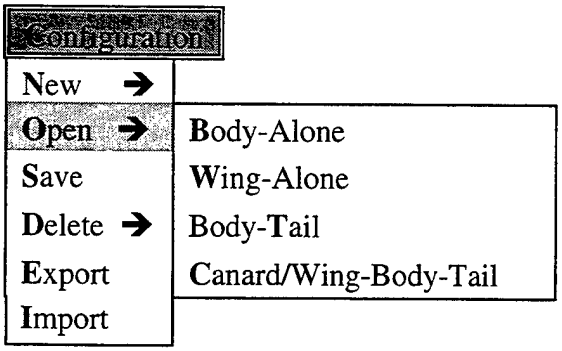
The choice of the Canard/Wing-Body-Tail second-tier menu option will cause a third-tier menu popup to be displayed. This menu popup will contain the following third-tier menu options that will allow the user to specify the lifting surface that is allowed to move:



The choice of either of the third-tier menu options will result in the enabling of the Inputs menu pad. (*This data corresponds to AP98 variable* ***NTYPE***.)

3.1.2.1.2 Configuration/Open

By choosing the Open menu option, the user can gain access to aeroprediction configuration files that have already been completed. The Open menu option will be enabled only when there are aeroprediction configuration files that have been previously saved by the user. For a discussion on saving aeroprediction configuration files, see Section 3.1.2.1.3. Upon choosing the Open menu option, a second-tier menu popup is displayed containing menu options for the following configuration types:



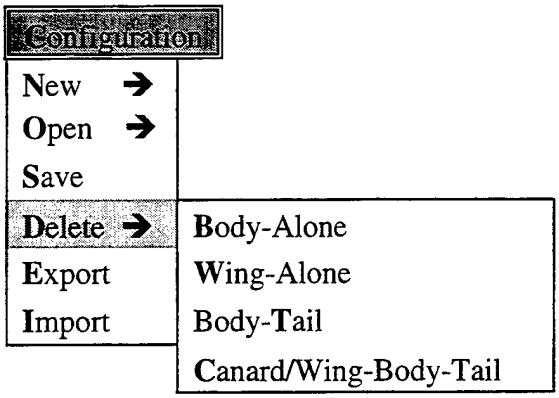
The enabling of any of these second-tier menu options will depend upon whether aeroprediction configuration files have been saved for the corresponding configuration type. If a second-tier menu option is enabled and chosen, the Configuration-Open File data entry screen will be displayed. See Section 3.2.1.1 for a discussion on the use of the Configuration-Open File data entry screen.

3.1.2.1.3 Configuration/Save

By choosing the Save menu option, the user can save a completed aeroprediction configuration file for future use. The Save menu option will be enabled only when the input of aeroprediction configuration data has been completed. The input of aeroprediction configurations is discussed in Section 3.1.2.2. Upon choosing the Save menu option, the Configuration-Save/Delete File data entry screen will be displayed. See Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

3.1.2.1.4 Configuration/Delete

The Delete menu option is useful when the user wants to get rid of any unwanted aeroprediction configuration files that are currently saved. The Delete menu option will be enabled only when there are aeroprediction configuration files that have been previously saved by the user. Upon choosing the Delete menu option, a second-tier menu popup is displayed containing menu options for the following configuration types:



The enabling of any of the second-tier menu options will depend upon whether aeroprediction configuration files have been saved for the corresponding configuration type. If a second-tier menu option is enabled and chosen, the Configuration-Save/Delete File data entry screen will be displayed. See Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

3.1.2.1.5 Configuration/Export

By choosing the Export menu option, the user can make an aeroprediction configuration file available to other users for use on their computers. The Export menu option will be enabled when input of aeroprediction configuration data has been completed, or when an aeroprediction configuration file has been either opened or imported. The input of aeroprediction configurations is discussed in Section 3.1.2.2. Upon choosing the Export menu option, the Configuration-Export data entry screen will be displayed. See Section 3.2.1.3 for a discussion on the use of the Configuration-Export data entry screen.

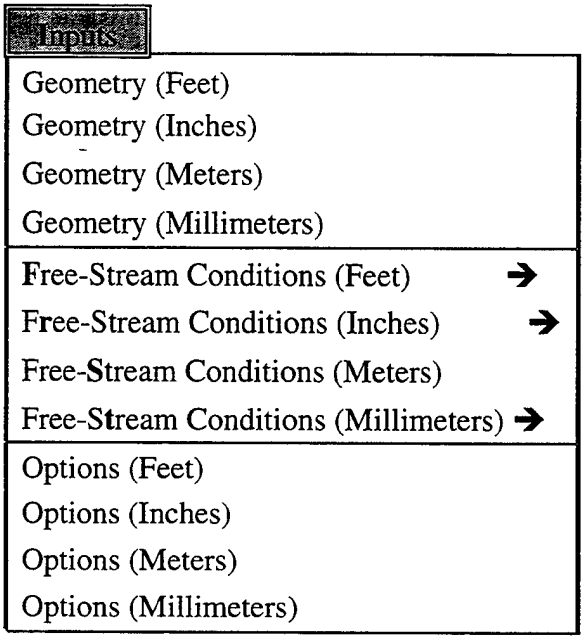
3.1.2.1.6 Configuration/Import

By choosing the Import menu option, the user can gain access to aeroprediction configuration files that have been generated by another user on another computer. The Import menu option is enabled when an aeroprediction configuration file has been previously exported or when an aeroprediction configuration file having a .EXP extension is detected in the AP98 directory. Aeroprediction configuration files having a .EXP extension may originate from another user's machine. Upon choosing the Import menu option, the Configuration-Import data entry screen will be displayed. The Configuration-Import data entry screen is identical in format and function to the Configuration-Open data entry screen. See Section 3.2.1.1 for a discussion on the use of the Configuration-Open File data entry screen.

3.1.2.2 Inputs

The Inputs menu pad (on the menu bar, page 15) is not enabled at program startup. It becomes enabled after the user has either chosen the configuration type for a new aeroprediction

configuration, opened a saved aeroprediction configuration, or imported an aeroprediction configuration. The Inputs menu pad is the controlling menu pad for the Inputs menu popup. The Inputs menu popup contains the menu options for creating a complete aeroprediction configuration file. When you choose the Inputs menu pad, the Inputs menu popup is displayed. The Inputs menu popup contains the following menu options:



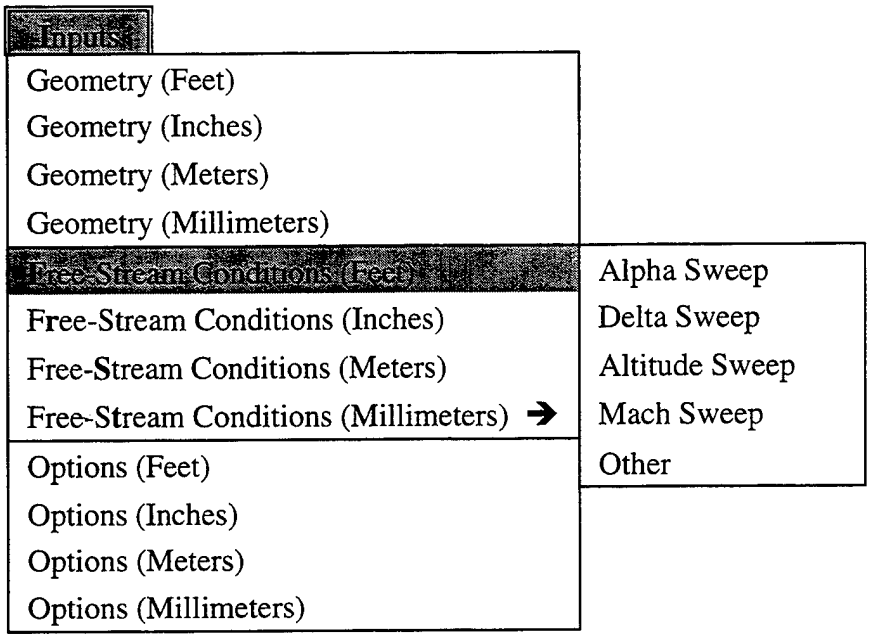
The user must have completed the input of geometry data, free-stream conditions data, and options data before an aeroprediction configuration file is considered to be complete.

3.1.2.2.1 Inputs/Geometry

The Geometry menu options are always enabled. By choosing a Geometry menu option, the user can begin the process of inputting aeroprediction configuration geometry data, in the units chosen, for the chosen configuration type. Upon choosing a Geometry menu option, an Aeroprediction Geometry data entry screen, corresponding to the chosen configuration type, will be displayed. The Aeroprediction Geometry data entry screens are discussed in Section 3.2.2.

3.1.2.2.2 Inputs/Free-Stream Conditions

The Free-Stream Conditions menu options are always enabled. By choosing a Free-Stream Conditions menu option, the user can begin the process of inputting aeroprediction configuration free-stream conditions data, in the units chosen. Upon choosing a Free-Stream Conditions menu option, a second-tier menu popup is displayed containing menu options for the following free-stream conditions:



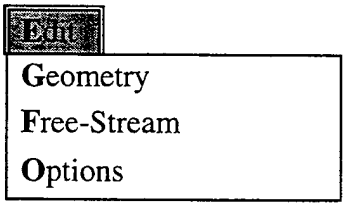
With the exception of the Delta Sweep menu option, all second-tier menu options are always enabled. The Delta Sweep menu option is disabled for the body-alone or wing-alone configuration types. If a second-tier menu option is enabled and chosen, a corresponding Free-Stream Conditions data entry screen will be displayed. The Free-Stream Conditions data entry screens are discussed in Section 3.2.3.

3.1.2.2.3 Inputs/Options

The Options menu options are enabled only when the user has completed the input of both the geometry data and the free-stream data, or when the user has opened a saved Aeroprediction configuration file. By choosing an Options menu option, the user can begin the process of inputting aeroprediction configuration options data, in the units chosen. Upon choosing an Options menu option, an Options data entry screen will be displayed. The Options data entry screens are discussed in Section 3.2.4.

3.1.2.3 Edit

The Edit menu pad (on the menu bar, page 15) is not enabled at program startup. It becomes enabled after the user has completed inputting aeroprediction configuration geometry data, has completed inputting aeroprediction configuration free-stream conditions, or has opened a saved aeroprediction configuration file. The Edit menu pad is the controlling menu pad for the Edit menu popup. The Edit menu popup contains the menu options for editing selected portions of an aeroprediction configuration. When you choose the Edit menu pad, the Edit menu popup is displayed. The Edit menu popup contains the following menu options:



Using the Edit menu options to alter the data in a saved aeroprediction configuration file will not change the saved file permanently. To make the editing alterations permanent, the user must use the Configuration-Save/Delete menu option. See Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

3.1.2.3.1 Edit/Geometry

The Geometry menu option is enabled after the user has either completed the input of the geometry data or opened a saved aeroprediction configuration file. By choosing the Geometry menu option, the user can begin the process of modifying the current aeroprediction configuration geometry data. Upon choosing the Geometry menu option, an Aeroprediction Geometry data entry screen, corresponding to the chosen configuration type, will be displayed. The Aeroprediction Geometry data entry screens are discussed in Section 3.2.2.

3.1.2.3.2 Edit/Free-Stream Conditions

The Free-Stream Conditions menu option is enabled after the user has either completed the input of the free-stream data, or opened a saved aeroprediction configuration file. By choosing the Free-Stream Conditions menu option, the user can begin the process of modifying the current aeroprediction configuration free-stream data. Upon choosing the Free-Stream Conditions menu option, an Aeroprediction Free-Stream Conditions data entry screen will be displayed. The Aeroprediction Free-Stream Conditions data entry screens are discussed in Section 3.2.3.

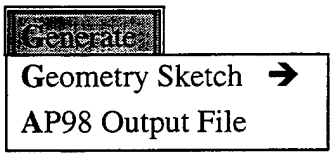
3.1.2.3.3 Edit/Options

The Options menu option is enabled after the user has either completed the input of options data or opened a saved aeroprediction configuration file. By choosing the Options menu option, the user can begin the process of modifying the current aeroprediction configuration options data. Upon choosing the options menu option, an Aeroprediction Options data entry screen will be displayed. The Aeroprediction Options data entry screens are discussed in Section 3.2.4.

3.1.2.4 Generate

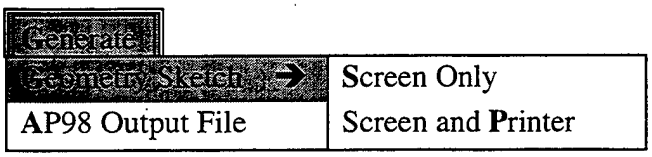
The Generate menu pad (on the menu bar, page 15) is not enabled at program startup. It becomes enabled after the user has completed the input of geometry data, opened a saved

aeroprediction configuration file, or imported an aeroprediction configuration file. The Generate menu pad is the controlling menu pad for the Generate menu popup. The Generate menu popup contains the menu options for creating a sketch of the input geometry, and for generating aerodynamic coefficients. When you choose the Generate menu pad, the Generate menu popup is displayed. The Generate menu popup contains the following menu options:



3.1.2.4.1 Generate/Sketch

The Geometry Sketch menu option is always enabled. Upon choosing the Geometry Sketch menu option, a second-tier menu popup is displayed.



If the Screen Only second-tier menu option is chosen, a sketch representing the missile geometry will be displayed on the screen. If the geometry is not a wing-alone geometry, then the sketch will include body cross-sectional shapes in addition to the missile body profile. The missile profile shown will be a top view of the missile such that the crossflow velocity vector is out of the screen. The body cross-sectional shapes will always be shown at the end of the nose and at the end of the missile. If there is a transition point where the body evolves from one type of cross-section to another, then the cross-sectional shape at the transition point will be displayed as well. The cross-sectional shapes are shown as seen from the front of the missile looking towards the rear of the missile such that the crossflow velocity vector points upwards on the screen. The planforms of any lifting surfaces will also be displayed. Figure 6 is an example of such a sketch. Hitting any key on the keyboard will remove the sketch and return the user to the AP98 Interface menu bar.

If the Screen and Printer second-tier menu option is chosen, then the aforementioned geometry sketching will result. Additionally, hitting any key on the keyboard will also result in the routing of the sketch to the printer before the user is returned to the AP98 Interface menu bar.

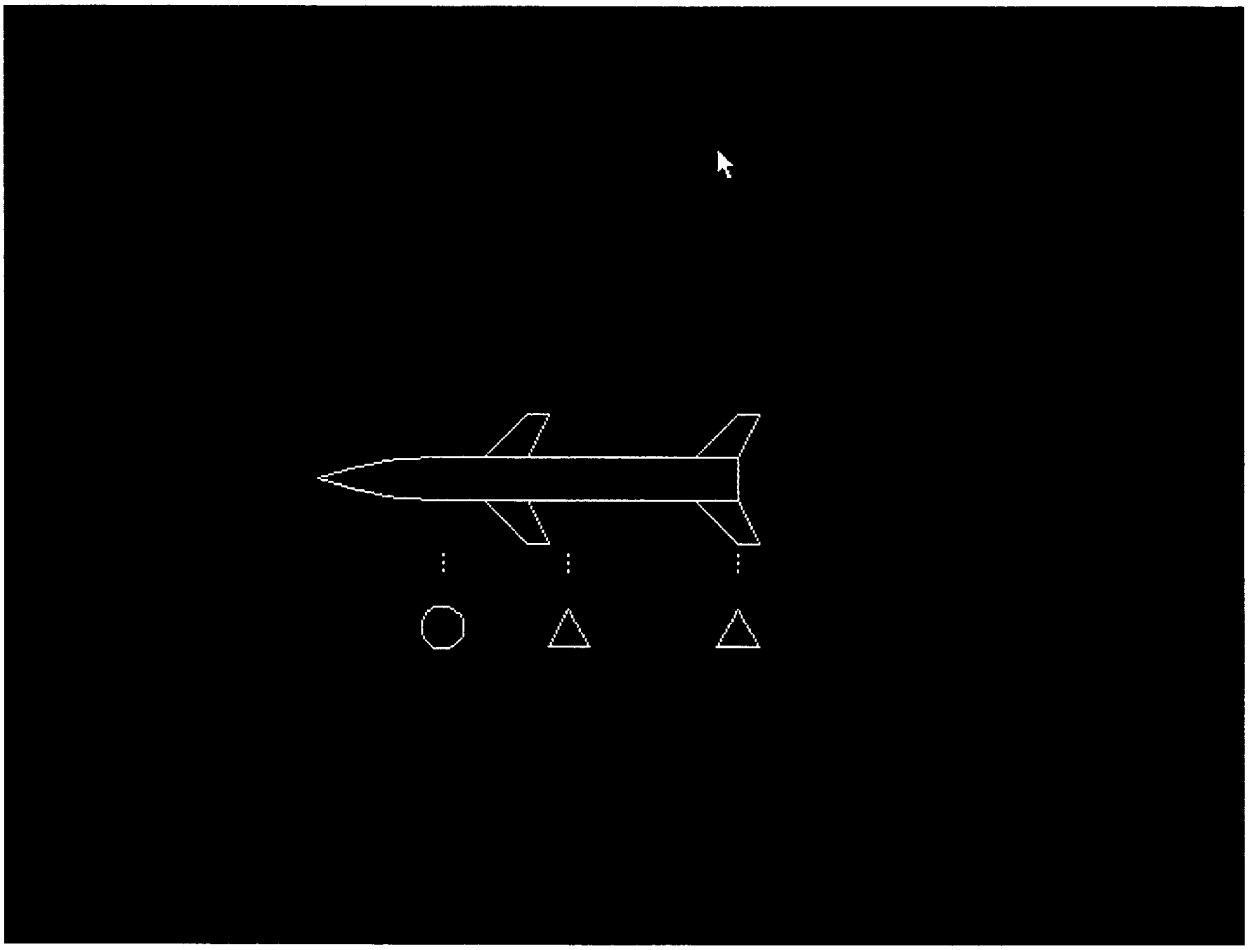


FIGURE 6. EXAMPLE OF GEOMETRY SKETCH

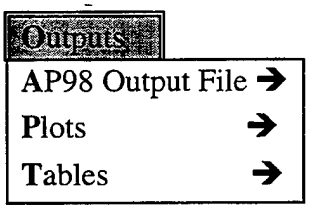
3.1.2.4.2 Generate/AP98 Output File

The AP98 Output File menu option is enabled when the user has completed the input of geometry data, free-stream conditions data, and options data. See Section 3.1.2.2 for a discussion of inputs. The AP98 Output File menu option is also enabled if the user has imported an aeroprediction configuration file or has opened a saved aeroprediction configuration file. Section 3.1.2.1.6 discusses the Configuration/Import menu option. See Section 3.2.1.1 for a discussion on the use of the Configuration-Open File data entry screen, and see Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

Upon choosing the AP98 Output File menu option, the following sequence of events occurs. First, an input file is generated using the current data stored in the AP98 interface. After the completion of the input file generation, the Aeroprediction code itself is executed to generate aerodynamic coefficients. Finally, the user is returned to the AP98 Interface menu bar. Although this sequence of events will be invisible to the user, messages are displayed periodically so that the user can monitor the progress. Hitting any key on the keyboard or clicking the mouse will remove the displayed messages thereby speeding up the process mentioned above.

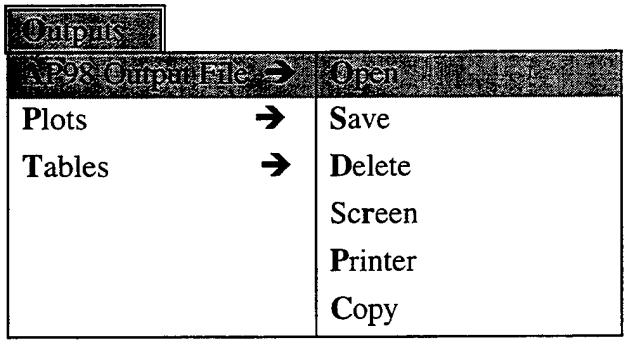
3.1.2.5 Outputs

The Outputs menu pad (on the menu bar, page 15) is enabled when the Generate/AP98 Output File option has been executed (see Section 3.1.2.4.2) or when the user has previously saved an AP98 output file (see Section 3.1.2.5.1.2). The Outputs menu pad is the controlling menu pad for the Outputs menu popup. The Outputs menu popup contains the menu options for viewing the results that have been generated by AP98. When you choose the Outputs menu pad, the Outputs menu popup is displayed. The Outputs menu popup contains the following menu options:



3.1.2.5.1 Outputs/AP98 Output File

The AP98 Output File menu option is always enabled. By choosing the AP98 Output File menu option, the user can open, save, delete, or view AP98 output results. Upon choosing the AP98 Output File menu option, a second-tier menu popup is displayed containing the following options:



3.1.2.5.1.1 Outputs/AP98 Output File/Open. The second-tier Open menu option will be enabled if an AP98 output file has been saved previously. Upon selecting the Open menu option, the AP98 Output File-Open File data entry screen will be displayed. The AP98 Output File-Open File data entry screen is operated in exactly the same way as the Configuration-Open File data entry screen (see Section 3.2.1.1).

3.1.2.5.1.2 Outputs/AP98 Output File/Save. The second-tier Save menu option will be enabled if the Generate/AP98 Output File menu option has been executed (see Section 3.1.2.4.2)

or if the Outputs/AP98 Output File/Open menu option has been executed (see Section 3.1.2.5.1.1). Upon selecting the Save menu option, the AP98 Output File-Save/Delete File data entry screen will be displayed. The AP98 Output File-Save/Delete File data entry screen is operated in exactly the same way as the Configuration-Save/Delete File data entry screen (see Section 3.2.1.2).

3.1.2.5.1.3 Outputs/AP98 Output File/Delete. The second-tier Delete menu option will be enabled if a AP98 output file has been saved previously. Upon selecting the Delete menu option, the AP98 Output File-Save/Delete File data entry screen will be displayed. The AP98 Output File-Save/Delete File data entry screen is operated in exactly the same way as the Configuration-Save/Delete File data entry screen (see Section 3.2.1.2).

3.1.2.5.1.4 Outputs/AP98 Output File/Screen. The second-tier Screen menu option will be enabled if the Generate/AP98 Output File menu option has been executed (see Section 3.1.2.4.2) or if the Outputs/AP98 Output File/Open menu option has been executed (see Section 3.1.2.5.1.1). Upon selecting the Screen menu option, the AP98 results will be transferred to the screen as shown in Figure 7.

The user can view the results by using the keyboard/mouse to scroll left/right or down. The "More" pushbutton will cause the next page of output to be displayed on the screen. The "Done" pushbutton will exit the results screen and return the user to the AP98 Interface menu bar (page 15).

3.1.2.5.1.5 Outputs/AP98 Output File/Printer. The second-tier Printer menu option will be enabled if the Generate/AP98 Output File menu option has been executed (see Section 3.1.2.4.2) or if the Outputs/AP98 Output File/Open menu option has been executed (see Section 3.1.2.5.1.1). Upon selecting the Printer menu option, the AP98 results will be transferred to the printer.

3.1.2.5.1.6 Outputs/AP98 Output File/Copy. The second-tier Copy menu option will be enabled if the Generate/AP98 Output File menu option has been executed (see Section 3.1.2.4.2) or if the Outputs/AP98 Output File/Open menu option has been executed (see Section 3.1.2.5.1.1). Upon selecting the Copy menu option, the AP98 Output File-Copy data entry screen will be displayed. The AP98 Output File-Copy data entry screen is operated in exactly the same way as the Configuration-Export data entry screen (see Section 3.2.1.3) with the exception that the DOS filename extension need not be "EXP."

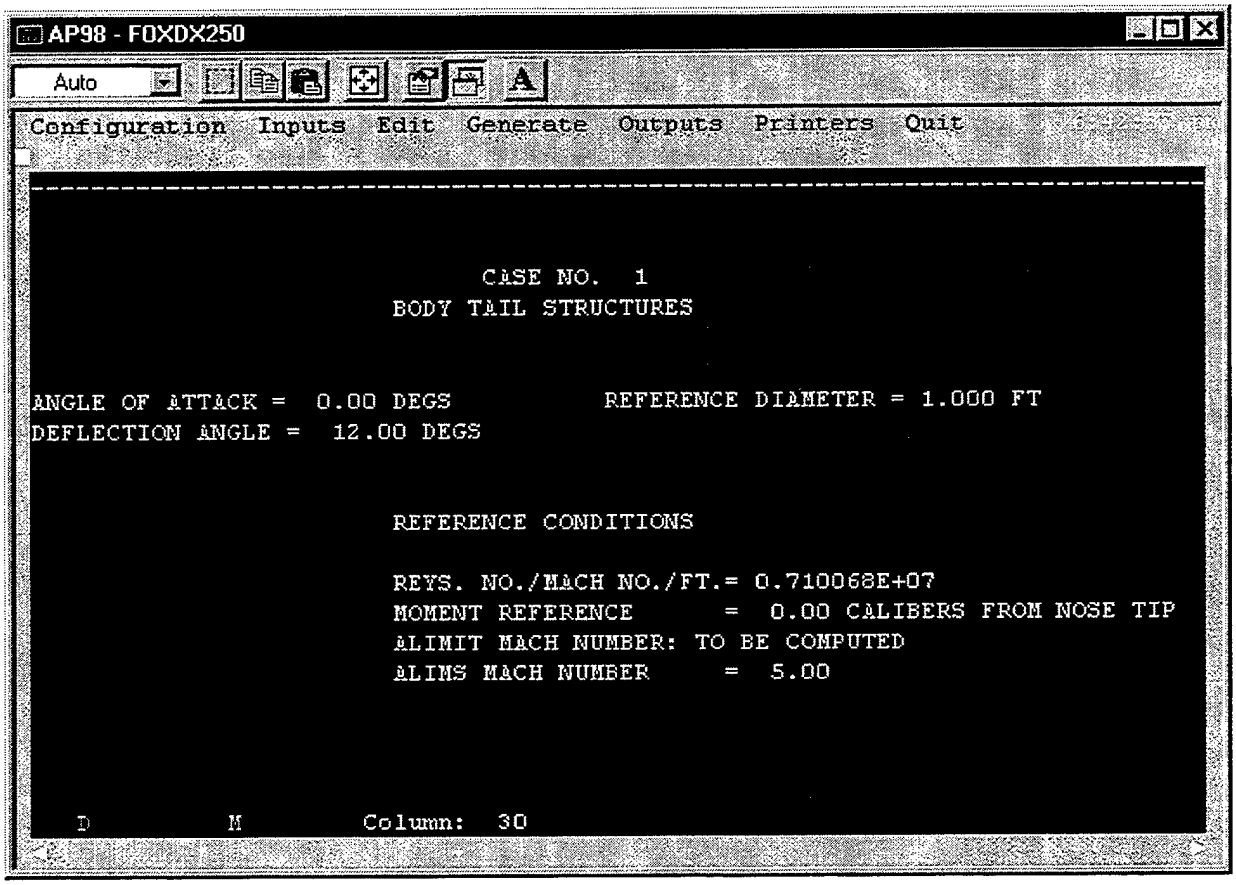
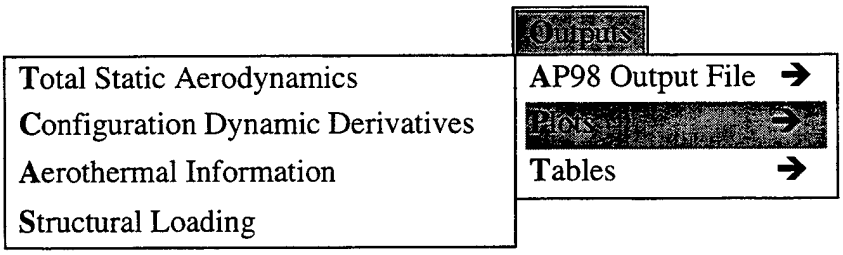


FIGURE 7. EXAMPLE OF AP98 RESULTS BEING SHOWN ON SCREEN

3.1.2.5.2 Outputs/Plots

The Plots menu option will be enabled if the Generate/AP98 Output File menu option has been executed (see Section 3.1.2.4.2) or if the Outputs/AP98 Output File/Open menu option has been executed (see Section 3.1.2.5.1.1). Upon selecting the Plots menu option, a second-tier menu popup is displayed containing the following options:



3.1.2.5.2.1 Outputs/Plots/Total Static Aerodynamics. The second-tier Total Static Aerodynamics menu option will be enabled if the Generate/AP98 Output File menu option has been executed (see Section 3.1.2.4.2) or if the Outputs/AP98 Output File/Open menu option has been executed (see Section 3.1.2.5.1.1). Upon selecting the Total Static Aerodynamics menu option, the Plots-Total Static Aerodynamics data entry screen will be displayed. See Section 3.2.5.1 for a discussion on the Plots-Total Static Aerodynamics data entry screen.

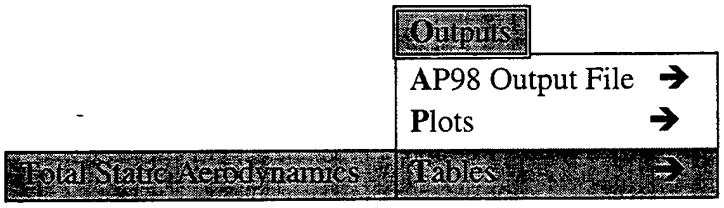
3.1.2.5.2.2 Outputs/Plots/Configuration Dynamic Derivatives. The second-tier Configuration Dynamic Derivatives menu option will be enabled if the Generate/AP98 Output File menu option has been executed (see Section 3.1.2.4.2) and the Dynamic Derivatives radio button has been set to "Yes" in the Aeroprediction-Options data entry screen (see Section 3.2.4.1). It will also be enabled if the Outputs/AP98 Output File/Open menu option has been executed (see Section 3.1.2.5.1.1) and the Dynamic Derivatives radio button had been set to "Yes" in the Aeroprediction-Options data entry screen during the creation of the opened file. Upon selecting the Configuration Dynamic Derivatives menu option, the Plots-Configuration Dynamic Derivatives data entry screen will be displayed. The Plots-Configuration Dynamic Derivatives data entry screen is operated in exactly the same way as the Plots-Total Static Aerodynamics data entry screen (see Section 3.2.5.1).

3.1.2.5.2.3 Outputs/Plots/Aerothermal Information. The second-tier Aerothermal Information menu option will be enabled if the Generate/AP98 Output File menu option has been executed (see Section 3.1.2.4.2) and the Pressure Coefficients Printing radio button has been set to "Pressure Coefficients, Strip Normal Forces, Aerothermal Information" in the Aeroprediction-Options data entry screen (see Section 3.2.4.1). It will also be enabled if the Outputs/AP98 Output File/Open menu option has been executed (see Section 3.1.2.5.1.1) and the Pressure Coefficients Printing radio button had been set to "Pressure Coefficients, Strip Normal Forces, Aerothermal Information" in the Aeroprediction-Options data entry screen during the creation of the opened file. Upon selection of the Aerothermal Information menu option, the Plots-Aerothermal Information data entry screen will be displayed. See Section 3.2.5.2 for a discussion on the Plots-Aerothermal Information data entry screen.

3.1.2.5.2.4 Outputs/Plots/Structural Loading. The second-tier Structural Loading menu option will be enabled if the Generate/AP98 Output File menu option has been executed (see Section 3.1.2.4.2) and the Pressure Coefficients Printing radio button has been set to "Structures Option" in the Aeroprediction-Options data entry screen (see Section 3.2.4.1). It will also be enabled if the Outputs/AP98 Output File/Open menu option has been executed (see Section 3.1.2.5.1.1) and the Pressure Coefficients Printing radio button had been set to "Structural Loading" in the Aeroprediction-Options data entry screen during the creation of the opened file. Upon selection of the Structural Loading menu option, the Plots-Structural Loading data entry screen will be displayed. See Section 3.2.5.3 for a discussion on the Plots-Structural Loading data entry screen.

3.1.2.5.3 Outputs/Tables

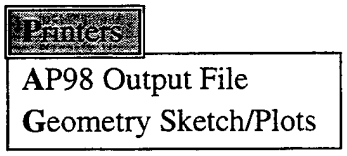
The Tables menu option will be enabled if the Generate/AP98 Output File menu option has been executed (see Section 3.1.2.4.2) or if the Outputs/AP98 Output File/Open menu option has been executed (see Section 3.1.2.5.1.1). Upon selecting the Tables menu option, a second-tier menu popup is displayed containing the following options:



3.1.2.5.3.1 Outputs/Tables/Total Static Aerodynamics. The second-tier Total Static Aerodynamics menu option will be enabled if the Generate/AP98 Output File menu option has been executed (see Section 3.1.2.4.2) or if the Outputs/AP98 Output File/Open menu option has been executed (see Section 3.1.2.5.1.1). Upon selecting the Total Static Aerodynamics menu option, the Tables-Total Static Aerodynamics data entry screen will be displayed. See Section 3.2.6 for a discussion on the Tables-Total Static Aerodynamics data entry screen.

3.1.2.6 Printers

The Printers menu pad (on the menu bar, page 15) is always enabled. The Printers menu pad is the controlling menu pad for the Printers menu popup. When you choose the Printers menu pad, the Printers menu popup is displayed. The Printers menu popup contains the following menu options:



3.1.2.6.1 Printers/AP98 Output File

The AP98 Output File menu option is always enabled. By choosing the AP98 Output File menu option, the user can specify the type of printer that aeroprediction output will be routed to. Upon choosing the AP98 Output File menu option, the Aeroprediction-AP98 Output File Printer Selection data entry screen will be displayed. See Section 3.2.7.1 for a discussion on the Aeroprediction-AP98 Output File Printer Selection data entry screen.

3.1.2.6.2 Printers/Geometry Sketch/Plots

The Geometry Sketch/Plots menu option is always enabled. By choosing the Geometry Sketch/Plots menu option, the user can specify the type of printer to which geometry sketches and plots will be routed. Upon choosing the Geometry Sketch/Plots menu option, the Aeroprediction-Geometry Sketch/Plots Printer Selection data entry screen will be displayed. See Section 3.2.7.2 for a discussion on the Aeroprediction-Geometry Sketch/Plots Printer Selection data entry screen.

3.1.2.7 Quit

The Quit menu pad (on the menu bar, page 15) is always enabled. Upon choosing the Quit menu pad, the user exits the AP98 Interface program. Any unsaved data will be lost.

3.2 AP98 INTERFACE DATA ENTRY SCREENS

The AP98 Interface data entry screens are the vehicles that are used to control the interface environment. They may be used to input aeroprediction configuration data or to control post processing of the results generated by aeroprediction. The following paragraphs discuss the AP98 Interface data entry screens.

3.2.1 Configuration Data Entry Screens

3.2.1.1 Configuration-Open File Data Entry Screen

The Configuration-Open File data entry screen is depicted in Figure 8.

The Configuration-Open File data entry screen consists of a list, a data field, and two pushbuttons to be used as follows:

Available Files list—The user can choose the aeroprediction configuration file to be opened from the list of available files. The list will contain only the names of files that were saved for the chosen configuration type.

Open File data field—The Open File data field is not enabled (i.e., data cannot be entered into this field by the user). When a file is chosen from the Available Files list, the file name will appear in the Open File data field.

FIGURE 8. CONFIGURATION-OPEN FILE DATA ENTRY SCREEN

OK pushbutton—The OK pushbutton is not enabled until there is a file name displayed in the Open File data field. By choosing the OK pushbutton, you are confirming that the aeroprediction configuration file that you want to open is identified by the file name displayed in the Open File data field. After choosing the OK pushbutton, the aeroprediction configuration file will be opened.

Cancel pushbutton—Choose the Cancel pushbutton to leave the Configuration-Open File data entry screen without opening a file.

3.2.1.2 Configuration-Save/Delete File Data Entry Screen

The Configuration-Save/Delete File data entry screen is depicted in Figure 9. It is the vehicle that is used for saving or deleting aeroprediction configuration files. The following paragraphs discuss the use of the Configuration-Save/Delete File data entry screen when saving and deleting aeroprediction configuration files.

FIGURE 9. CONFIGURATION-SAVE/DELETE FILE DATA ENTRY SCREEN

3.2.1.2.1 Saving Aeroprediction Configuration Files

The Configuration-Save/Delete File data entry screen consists of a list, a data field, and three pushbuttons to be used as follows when saving aeroprediction configuration files:

Saved Files list—The Saved Files list will contain only the names of files that were saved for the configuration type of the current aeroprediction configuration inputs. The user can choose an existing aeroprediction configuration file from the list of saved files.

File Name data field—The File Name data field is always enabled. There are two methods that can be used to enter data into this field.

1) Choose an existing aeroprediction configuration file from the Saved Files list.

2) Select the File Name data field, type the desired file name, and press the Enter key.

Save pushbutton—The Save pushbutton is not enabled until there is a file name displayed in the File Name data field. By choosing the Save pushbutton, you are confirming that the aeroprediction configuration file to be saved will be identified by the file name

displayed in the File Name data field. After choosing the Save pushbutton, the aeroprediction configuration file will be generated and saved. If the file name originated from the Saved Files list, the previously saved file with that name will be overwritten.

Delete pushbutton—The Delete pushbutton will become enabled when there is a file name displayed in the File Name data field. This pushbutton should not be used when saving files.

Cancel pushbutton—Choose the Cancel pushbutton to leave the Configuration-Save/Delete File data entry screen without saving a file.

3.2.1.2.2 Deleting Aeroprediction Configuration Files

The Configuration-Save/Delete File data entry screen consists of a list, a data field, and three pushbuttons to be used as follows when deleting aeroprediction configuration files:

Saved Files list—The Saved Files list will contain only the names of files that were saved for the chosen configuration type. The user can choose the aeroprediction configuration file to be deleted from the list of saved files.

File Name data field—The File Name data field is always enabled. There are two methods that can be used to enter data into this field.

1) Choose an existing aeroprediction configuration file from the Saved Files list.

2) Select the File Name data field, type the desired file name, and press the Enter key.

Save pushbutton—The Save pushbutton will become enabled when there is a file name displayed in the File Name data field. This pushbutton should not be used when deleting files.

Delete pushbutton—The Delete pushbutton will become enabled when there is a file name displayed in the File Name data field. By choosing the Delete pushbutton, you are confirming that the aeroprediction configuration file to be deleted is identified by the file name displayed in the File Name data field. After choosing the Delete pushbutton, the delete confirmation screen shown in Figure 10 will be displayed. When in the delete confirmation screen, choosing the "Yes" pushbutton causes the aeroprediction configuration file to be deleted. If you choose the "No" pushbutton, the file will not be deleted. In either case, you will leave the delete confirmation screen and return to the AP98 Interface startup screen.

Cancel pushbutton—Choose the Cancel pushbutton to leave the Configuration-Save/Delete File data entry screen without deleting a file.

FIGURE 10. DELETE FILE CONFIRMATION SCREEN

3.2.1.3 Configuration-Export Data Entry Screen

The Configuration-Export data entry screen is depicted in Figure 11. It is the vehicle that is used for exporting aeroprediction configuration files. Exported aeroprediction files can be identified by their extension ".EXP" and may be imported onto another user's computer (see Section 3.1.2.1.6 for a discussion on importing aeroprediction configuration files).

The Configuration-Export data entry screen consists of a data field and two pushbuttons to be used as follows when exporting aeroprediction configuration files:

Enter DOS Filename, Excluding Extension data field—The Enter DOS Filename, Excluding Extension data field is always enabled. When entering the desired filename, the user should omit any filename extension.

OK pushbutton—The OK pushbutton is not enabled until there is a file name displayed in the Enter DOS Filename, Excluding Extension data field. After choosing the OK pushbutton, the current aeroprediction configuration file will be exported to DOS with the specified name and an .EXP extension.

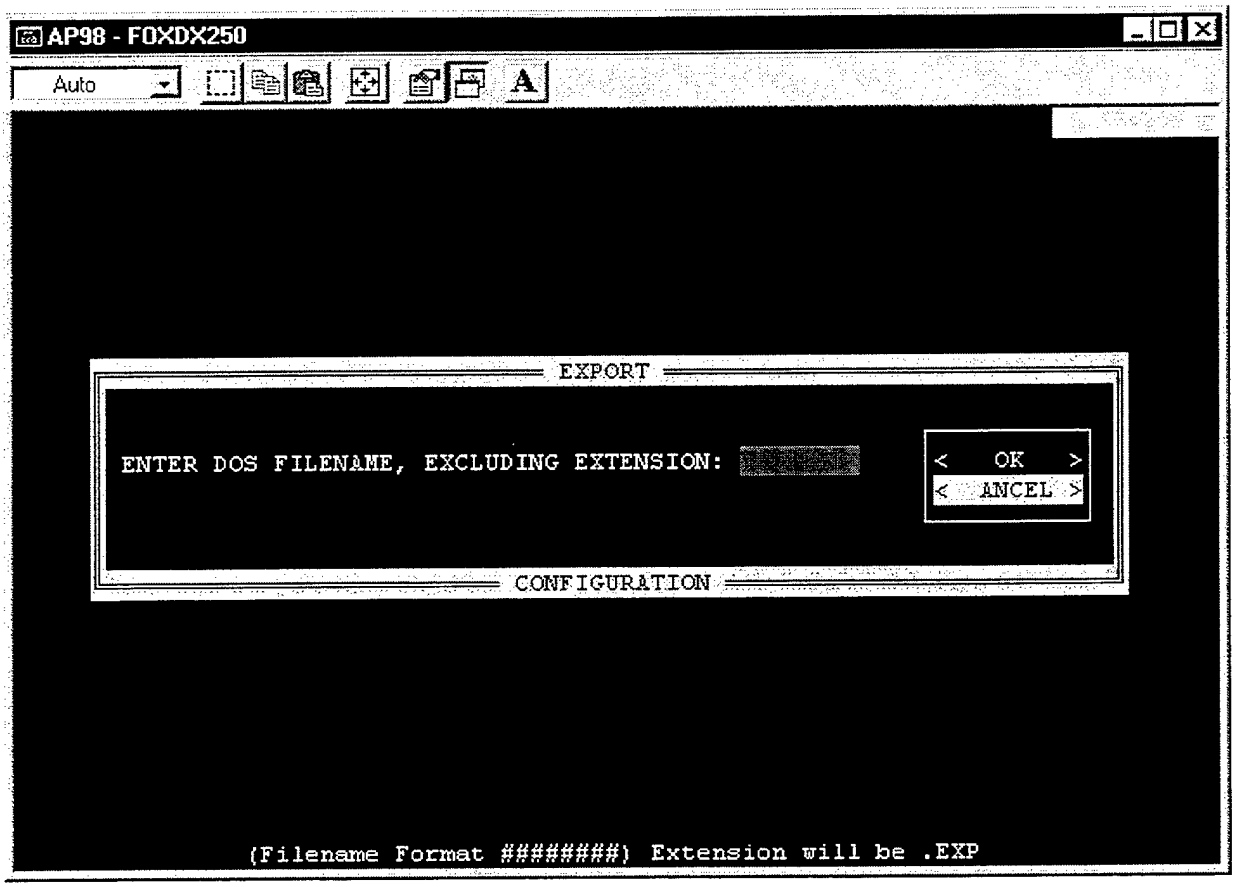


FIGURE 11. CONFIGURATION-EXPORT DATA ENTRY SCREEN

Cancel pushbutton—Choose the Cancel pushbutton to leave the Configuration-Export data entry screen without exporting a file.

3.2.2 Aeroprediction Geometry Data Entry Screens

3.2.2.1 Aeroprediction-Body-Alone Geometry Data Entry Screen

The Aeroprediction-Body-Alone Geometry data entry screen is depicted in Figure 12.

This data entry screen provides the user the means in which to describe the geometry of a missile body that has no lifting surfaces. This screen consists of six pushbuttons, one popup control, two sets of radio buttons, and three data fields to be used as follows:

Nose Geometry pushbutton—This pushbutton is always enabled, and should be selected when the user is ready to describe the missile nose geometry. The choice of this pushbutton will result in the display of the Geometry-Nose data entry screen. See Section 3.2.2.5.1 for a discussion on the Geometry-Nose data entry screen.

FIGURE 12. AEROPREDICTION-BODY-ALONE GEOMETRY DATA ENTRY SCREEN

Afterbody Geometry pushbutton—The Afterbody Geometry pushbutton is initially disabled. It becomes enabled after the user has completed entry of data into the Geometry-Nose data entry screen (see Section 3.2.2.5.1). The Afterbody Geometry pushbutton provides access to those data entry screens which allow the user to define the missile afterbody. Selection of the Afterbody Geometry pushbutton will result in the display of the Geometry-Afterbody data entry screen. See Section 3.2.2.6.1 for a discussion on the Geometry-Afterbody data entry screen.

Body Roughness popup control—The Body Roughness popup control contains the following Body Roughness popup options:

- Typical Flight Configuration
- Model With Boundary Layer Trip
- Laminar Flow Over Entire Model
- Smooth Model With No Boundary Layer Trip

The choice of a Body Roughness popup option is not mandatory. The "Typical Flight Configuration" popup option is selected as the default. The location of the boundary layer transition on the body will be determined by the Body Roughness popup option that is chosen. (*This data corresponds to AP98 variable **IRNCRIT**.*)

Boattail/Flare radio buttons—The Boattail/Flare radio buttons become enabled after the user completes entry of data into the Geometry-Afterbody data entry screen (see Section 3.2.2.6.1). The choice of a Boattail/Flare radio button is not mandatory. The "No" radio button is selected as the default. Choosing the "No" radio button will result in an afterbody geometry without a boattail/flare. Choosing the "Yes" radio button will result in the display of the Afterbody Geometry-Boattail/Flare data entry screen. For a discussion of the Afterbody Geometry-Boattail/Flare data entry screen, see Section 3.2.2.6.4. (*This data corresponds to AP98 variable **X(I)**, **WMHALF(I)**.*)

Radial Height Of Rotating Band Above Body Surface data field—The entry of data into the Radial Height Of Rotating Band Above Body Surface data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **HB**.*)

Reference Diameter Or Width Of The Body data field—The entry of data into the Reference Diameter Or Width Of The Body data field is mandatory. The Reference Diameter Or Width Of The Body must be the diameter or width at the end of the nose. (*This data corresponds to AP98 variable **WIDTH**.*)

Distance Of Moment Reference From Nose Tip data field—The entry of data into the Distance Of Moment Reference From Nose Tip data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **XCG**.*)

Wind Tunnel Reference Area Indicator radio button—The Wind Tunnel Reference Area Indicator radio button is always enabled. The choice of a Wind Tunnel Reference Area Indicator radio button is not mandatory. The "Equivalent Circular Area" radio button is selected as the default. (*This data corresponds to AP98 variable* **IREF**.)

OK pushbutton—The OK pushbutton is not enabled until the user completes the data entry for the Geometry-Nose and the Geometry-Afterbody data entry screens. By choosing the OK pushbutton, you are confirming that the data entered into these data entry screens is correct, and that data entry into the Aeroprediction-Body-Alone Geometry data entry screen is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Open pushbutton—The Open pushbutton will be enabled only when there are body-alone geometry files that have been previously saved by the user. The choice of this pushbutton will result in the display of the Body-Alone Geometry-Open File data entry screen. The user can use the Body-Alone Geometry-Open File data entry screen for opening body-alone geometry files in exactly the same manner as the Configuration-Open File data

entry screen is used for opening aeroprediction configuration files. See Section 3.2.1.1 for a discussion of the use of the Configuration-Open File data entry screen.

Save/Delete pushbutton—The Save/Delete pushbutton will be enabled only when either of the following two conditions are met:

1) The user has completed the data entry for the Geometry Nose and Geometry Afterbody data entry screens.

2) There are body-alone geometry files that have been previously saved by the user.

The choice of this pushbutton will result in the display of the Body-Alone Geometry-Save/Delete File data entry screen. The user can use the Body-Alone Geometry-Save/Delete File data entry screen for saving and deleting body-alone geometry files in exactly the same manner as the Configuration-Save/Delete File data entry screen is used for saving and deleting aeroprediction configuration files. See Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Aeroprediction-Body-Alone Geometry data entry screen without processing the body-alone geometry data.

3.2.2.2 Aeroprediction-Wing-Alone Geometry Data Entry Screen

The Aeroprediction-Wing-Alone Geometry data entry screen is depicted in Figure 13.

The Aeroprediction-Wing-Alone Geometry data entry screen consists of a popup control and four pushbuttons to be used as follows:

Wing popup control—The Wing popup control contains the following Wing popup options:

- Double-Wedge Airfoil
- Biconvex Airfoil
- Alter Planform

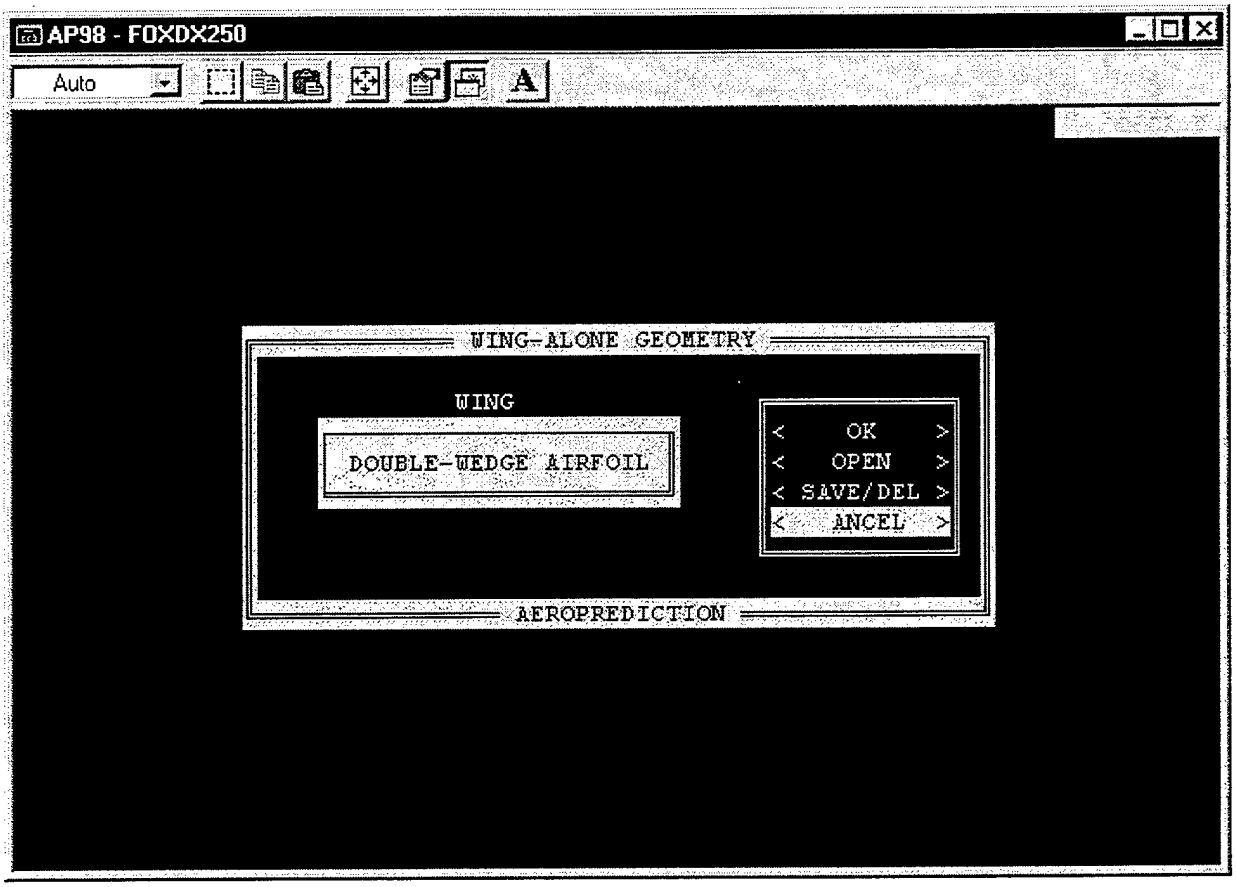


FIGURE 13. AEROPREDICTION-WING-ALONE GEOMETRY
DATA ENTRY SCREEN

The choice of a Wing popup option is mandatory. Choosing the "Double-Wedge Airfoil" popup option will result in the display of the Tail Geometry-Double-Wedge Airfoil data entry screen. For a discussion of the Tail Geometry-Double-Wedge Airfoil data entry screen, see Section 3.2.2.7.1. The choice of the "Biconvex Airfoil" popup option will result in the display of the Tail Geometry-Biconvex Airfoil data entry screen. For a discussion of the Tail Geometry-Biconvex Airfoil data entry screen, see Section 3.2.2.7.2. The choice of the "Alter Planform" popup option will result in the display of the Tail Geometry-Alter Planform data entry screen. For a discussion of the Tail Geometry-Alter Planform data entry screen, see Section 3.2.2.7.3. (*This data corresponds to AP98 variables **IW** and **IC**.*)

OK pushbutton—The OK pushbutton is not enabled until the user completes the data entry for the Wing option. By choosing the OK pushbutton, you are confirming that the option displayed in the popup control is correct, and data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Open pushbutton—The Open pushbutton will be enabled only when there are Wing-Alone geometry files that have been previously saved by the user. The choice of this pushbutton will result in the display of the Wing-Alone Geometry-Open File data entry screen. The user can use the Wing-Alone Geometry-Open File data entry screen for opening Wing-Alone geometry files in exactly the same manner that the Configuration-Open File data entry screen is used for opening aeroprediction configuration files. See Section 3.2.1.1 for a discussion on the use of the Configuration-Open File data entry screen.

Save/Delete pushbutton—The Save/Delete pushbutton will be enabled only when either of the following two conditions are met:

1) The user has completed the data entry for the Wing option.

2) There are Wing-Alone geometry files that have been previously saved by the user.

The choice of this pushbutton will result in the display of the Wing-Alone Geometry-Save/Delete File data entry screen. The user can use the Wing-Alone Geometry-Save/Delete File data entry screen for saving and deleting nose geometry files in exactly the same manner as the Configuration-Save/Delete File data entry screen is used for saving and deleting aeroprediction configuration files. See Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Aeroprediction-Wing-Alone Geometry data entry screen without processing the wing-alone geometry data.

3.2.2.3 Aeroprediction-Body-Tail Geometry Data Entry Screen

The Aeroprediction-Body-Tail Geometry data entry screen is depicted in Figure 14.

The Aeroprediction-Body-Tail Geometry data entry screen provides the user the means in which to describe the geometry of a missile body that has one set of lifting surfaces. The screen consists of six pushbuttons, two popup controls, two sets of radio buttons, and four data fields to be used as follows:

Nose Geometry pushbutton—See the discussion of the Nose Geometry pushbutton in Section 3.2.2.1.

Afterbody Geometry pushbutton—See the discussion of the Afterbody Geometry pushbutton in Section 3.2.2.1.

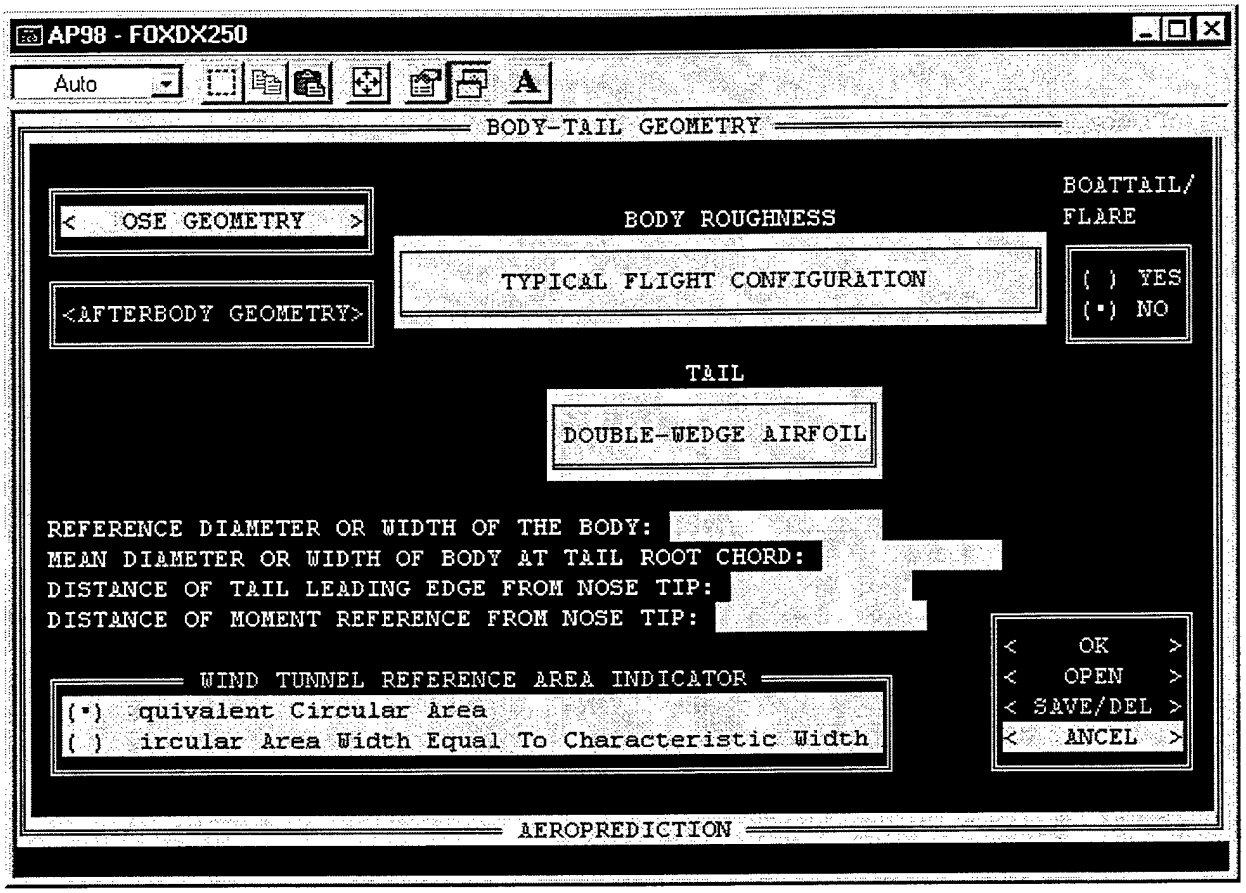


FIGURE 14. AEROPREDICTION-BODY-TAIL GEOMETRY DATA ENTRY SCREEN

Body Roughness popup control—See the discussion of the Body Roughness popup control in Section 3.2.2.1.

Boattail/Flare radio buttons—See the discussion of the Boattail/Flare radio buttons in Section 3.2.2.1.

Tail popup control—See the discussion of the Wing popup control in Section 3.2.2.2.

Reference Diameter Or Width Of The Body data field—The entry of data into the Reference Diameter Or Width Of The Body data field is mandatory. The Reference Diameter Or Width Of The Body must be the diameter or width at the end of the nose. (*This data corresponds to AP98 variable **WIDTH**.*)

Mean Diameter Or Width Of Body At Tail Root Chord data field—The entry of data into the Mean Diameter Or Width Of Body At Tail Root Chord data field is mandatory. (*This data corresponds to AP98 variable **DW**.*)

Distance Of Tail Leading Edge From Nose Tip data field—The entry of data into the Distance Of Tail Leading Edge From Nose Tip data field is mandatory. (*This data corresponds to AP98 variable **XW**.*)

Distance Of Moment Reference From Nose Tip data field—The entry of data into the Distance Of Moment Reference From Nose Tip data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **XCG**.*)

Wind Tunnel Reference Area Indicator radio button—See the discussion of the Wind Tunnel Reference Area Indicator radio button in Section 3.2.2.1.

OK pushbutton—The OK pushbutton is not enabled until the user completes the data entry for the Geometry-Nose data entry screen, the Geometry-Afterbody data entry screen, and the Tail menu popup. By choosing the OK pushbutton, you are confirming that the data entered is correct, and that data entry into the Aeroprediction-Body-Tail Geometry data entry screen is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Open pushbutton—The Open pushbutton will be enabled only when there are body-tail geometry files that have been previously saved by the user. The choice of this pushbutton will result in the display of the Body-Tail Geometry-Open File data entry screen. The user can use the Body-Tail Geometry-Open File data entry screen for opening body-tail geometry files in exactly the same manner as the Configuration-Open File data entry screen is used for opening aeroprediction configuration files. See Section 3.2.1.1 for a discussion on the use of the Configuration-Open File data entry screen.

Save/Delete pushbutton—The Save/Delete pushbutton will be enabled only when either of the following two conditions are met:

1) The user has completed the data entry for the Geometry Nose data entry screen, the Geometry Afterbody data entry screen, and the Tail menu popup.

2) There are body-tail geometry files that have been previously saved by the user.

The choice of this pushbutton will result in the display of the Body-Tail Geometry-Save/Delete File data entry screen. The user can use the Body-Tail Geometry-Save/Delete File data entry screen for saving and deleting body-tail geometry files in exactly the same manner as the Configuration-Save/Delete File data entry screen is used for saving and deleting aeroprediction configuration files. See Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Aeroprediction-Body-Tail Geometry data entry screen without processing the body-tail geometry data.

3.2.2.4 Aeroprediction-Canard/Wing-Body-Tail Geometry Data Entry Screen

The Aeroprediction-Canard/Wing-Body-Tail Geometry data entry screen is depicted in Figure 15. This data entry screen provides the user the means in which to describe the geometry of a missile body that has two sets of lifting surfaces. It consists of six pushbuttons, three popup controls, two sets of radio buttons, and six data fields to be used as follows:

Nose Geometry pushbutton—See the discussion of the Nose Geometry pushbutton in Section 3.2.2.1.

Afterbody Geometry pushbutton—See the discussion of the Afterbody Geometry pushbutton in Section 3.2.2.1.

Body Roughness popup control—See the discussion of the Body Roughness popup control in Section 3.2.2.1.

Boattail/Flare radio buttons—See the discussion of the Boattail/Flare radio buttons in Section 3.2.2.1.

Canard/Wing popup control—See the discussion of the Wing popup control in Section 3.2.2.2.

Tail popup control—See the discussion of the Wing popup control in Section 3.2.2.2.

Reference Diameter Or Width Of The Body data field—The entry of data into the Reference Diameter Or Width Of The Body data field is mandatory. The Reference Diameter Or Width Of The Body must be the diameter or width at the end of the nose. (*This data corresponds to AP98 variable **WIDTH**.*)

Mean Diameter Or Width Of Body At Canard/Wing Root Chord data field—The entry of data into the Mean Diameter Or Width Of Body At Canard/Wing Root Chord data field is mandatory. (*This data corresponds to AP98 variable **DC**.*)

Mean Diameter Or Width Of Body At Tail Root Chord data field—The entry of data into the Mean Diameter Or Width Of Body At Tail Root Chord data field is mandatory. (*This data corresponds to AP98 variable **DW**.*)

Distance Of Canard/Wing Leading Edge From Nose Tip data field—The entry of data into the Distance Of Canard/Wing Leading Edge From Nose Tip data field is mandatory. (*This data corresponds to AP98 variable **X/C**.*)

Distance Of Tail Leading Edge From Nose Tip data field—The entry of data into the Distance Of Tail Leading Edge From Nose Tip data field is mandatory. (*This data corresponds to AP98 variable **XW**.*)

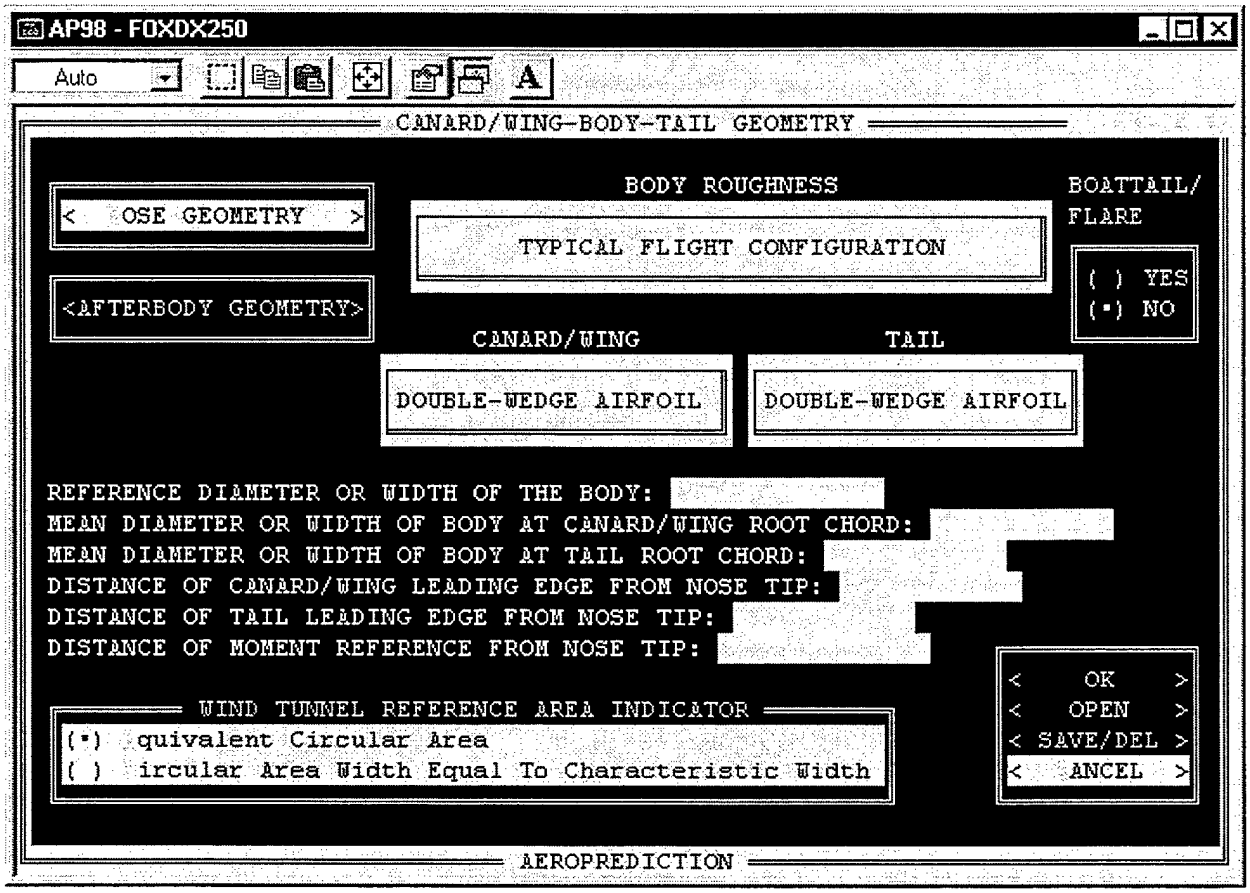


FIGURE 15. AEROPREDICTION-CANARD/WING-BODY-TAIL GEOMETRY DATA ENTRY SCREEN

Distance Of Moment Reference From Nose Tip data field—The entry of data into the Distance Of Moment Reference From Nose Tip data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **XCG**.*)

Wind Tunnel Reference Area Indicator radio button—See the discussion of the Wind Tunnel Reference Area Indicator radio button in Section 3.2.2.1.

OK pushbutton—The OK pushbutton is not enabled until the user completes the data entry for the Geometry-Nose data entry screen, the Geometry-Afterbody data entry screen, the Canard/Wing menu popup, and the Tail menu popup. By choosing the OK pushbutton, you are confirming that the data entered is correct, and that data entry into the Aeroprediction-Canard/Wing-Body-Tail Geometry data entry screen is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Open pushbutton—The Open pushbutton will be enabled only when there are canard/wing-body-tail geometry files that have been previously saved by the user. The choice of this pushbutton will result in the display of the Canard/Wing-Body-Tail

Geometry-Open File data entry screen. The user can use the Canard/Wing-Body-Tail Geometry-Open File data entry screen for opening canard/wing-body-tail geometry files in exactly the same manner as the Configuration-Open File data entry screen is used for opening aeroprediction configuration files. See Section 3.2.1.1 for a discussion on the use of the Configuration-Open File data entry screen.

Save/Delete pushbutton—The Save/Delete pushbutton will be enabled only when either of the following two conditions are met:

1) The user has completed the data entry for the Geometry Nose data entry screen, the Geometry Afterbody data entry screen, the Canard/Wing menu popup, and the Tail menu popup.

2) There are canard/wing-body-tail geometry files that have been previously saved by the user.

The choice of this pushbutton will result in the display of the Canard/Wing-Body-Tail Geometry-Save/Delete File data entry screen. The user can use the Canard/Wing-Body-Tail Geometry-Save/Delete File data entry screen for saving and deleting body-tail geometry files in exactly the same manner as the Configuration-Save/Delete File data entry screen is used for saving and deleting aeroprediction configuration files. See Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Aeroprediction-Canard/Wing-Body-Tail Geometry data entry screen without processing the canard/wing-body-tail geometry data.

3.2.2.5 Nose Geometry Data Entry Screens

3.2.2.5.1 Geometry-Nose Data Entry Screen

The Geometry-Nose data entry screen is depicted in Figure 16. This data entry screen provides the user the means in which to describe the geometry of the nose of a missile. It consists of two popup controls, three pushbuttons, and four data fields to be used as follows:

Nose Cross Sectional Shape popup control—The Nose Cross Sectional Shape popup control is always enabled and contains the following Nose Cross Sectional Shape popup options:

- Circular
- Elliptical

FIGURE 16. GEOMETRY-NOSE DATA ENTRY SCREEN

- Square
- Diamond
- Triangle
- Inverted Triangle

The user should choose that menu option which best represents the cross sectional shape at the end of the nose. The choice of a Nose Cross Sectional Shape menu option is mandatory, and the default option is "Circular". (*This data corresponds to AP98 variable **ICROSS(1)**.*)

Display Options pushbutton—The Display Options pushbutton is always enabled. Upon choosing the Display Options pushbutton, a graphic, such as the one shown in Figure 17, containing the various cross sectional shape options will be displayed. The purpose of the graphic is to familiarize the user with the physical dimensions associated with the various AP98 input parameters. Hitting any key on the keyboard will remove the graphic and return the user to the Geometry-Nose data entry screen.

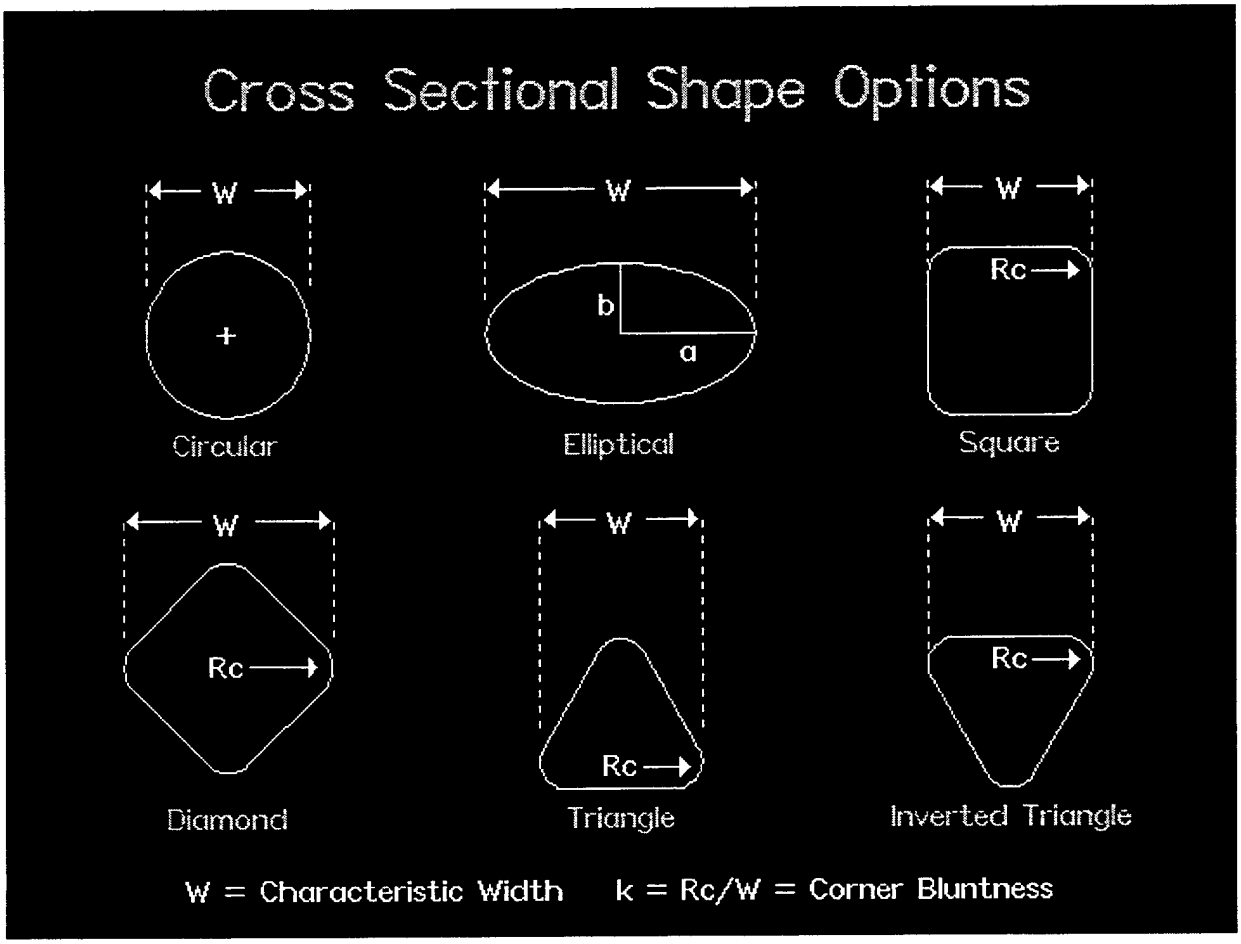


FIGURE 17. DISPLAY OPTIONS GRAPHIC

Circular Radius At End Of Nose data field—The Circular Radius At End Of Nose data field will be enabled when the "Circular" popup option has been chosen from the Nose Cross Sectional Shape popup menu. When enabled, the entry of data into this data field is mandatory. (*This data corresponds to AP98 variable* ***WIDTH***.)

A/B Ratio data field—The A/B Ratio data field will be enabled when the "Elliptical" popup option has been chosen from the Nose Cross Sectional Shape popup menu. When enabled, the entry of data into this data field is mandatory. (*This data corresponds to AP98 variable* ***AOVERB(1)***.)

Corner Bluntness (k) At End Of Nose data field—The Corner Bluntness (k) At End Of Nose will be enabled when the "Square," "Diamond," "Triangle," or "Inverted Triangle" popup option has been chosen from the Nose Cross Sectional Shape popup menu. When enabled, the entry of data into this data field is mandatory. (*This data corresponds to AP98 variable* ***CORK(1)***.)

Characteristic Blunted Width At End Of Nose data field—The Characteristic Blunted Width At End of Nose data field will be enabled when the "Elliptical," "Square," "Diamond," "Triangle," or "Inverted Triangle" popup option has been chosen from the Nose Cross Sectional Shape popup menu. When enabled, the entry of data into this data field is mandatory. (*This data corresponds to AP98 variable* ***WIDTH***.)

Nose Profile popup control—The Nose Profile popup control becomes enabled after the user has selected a Nose Cross Sectional Shape popup option and has completed entry of data into the associated data fields as described above. The Nose Profile popup control contains the following Nose Profile popup options:

- Tangent Ogive Pointed
- Tangent Ogive Blunt
- Tangent Ogive Truncated
- Von Karman Ogive Blunt
- Von Karman Ogive Truncated
- Secant Ogive Pointed
- Secant Ogive Blunt
- Secant Ogive Truncated
- Haack Nose Pointed
- Haack Nose Blunt
- Haack Nose Truncated
- Cone Pointed
- Cone Blunt
- Cone Truncated
- Power Series Pointed
- Power Series Blunt
- Power Series Truncated

- Hemisphere
- Other

The choice of a Nose Profile popup option is mandatory (i.e., until the user chooses a Nose Profile popup option, the geometry is considered incomplete). Choosing an option other than "Hemisphere" or "Other" will result in the display of an associated Nose Geometry data entry screen, similar to the screen displayed in Figure 18, and the user will be required to enter amplifying data as listed in the Table 1.

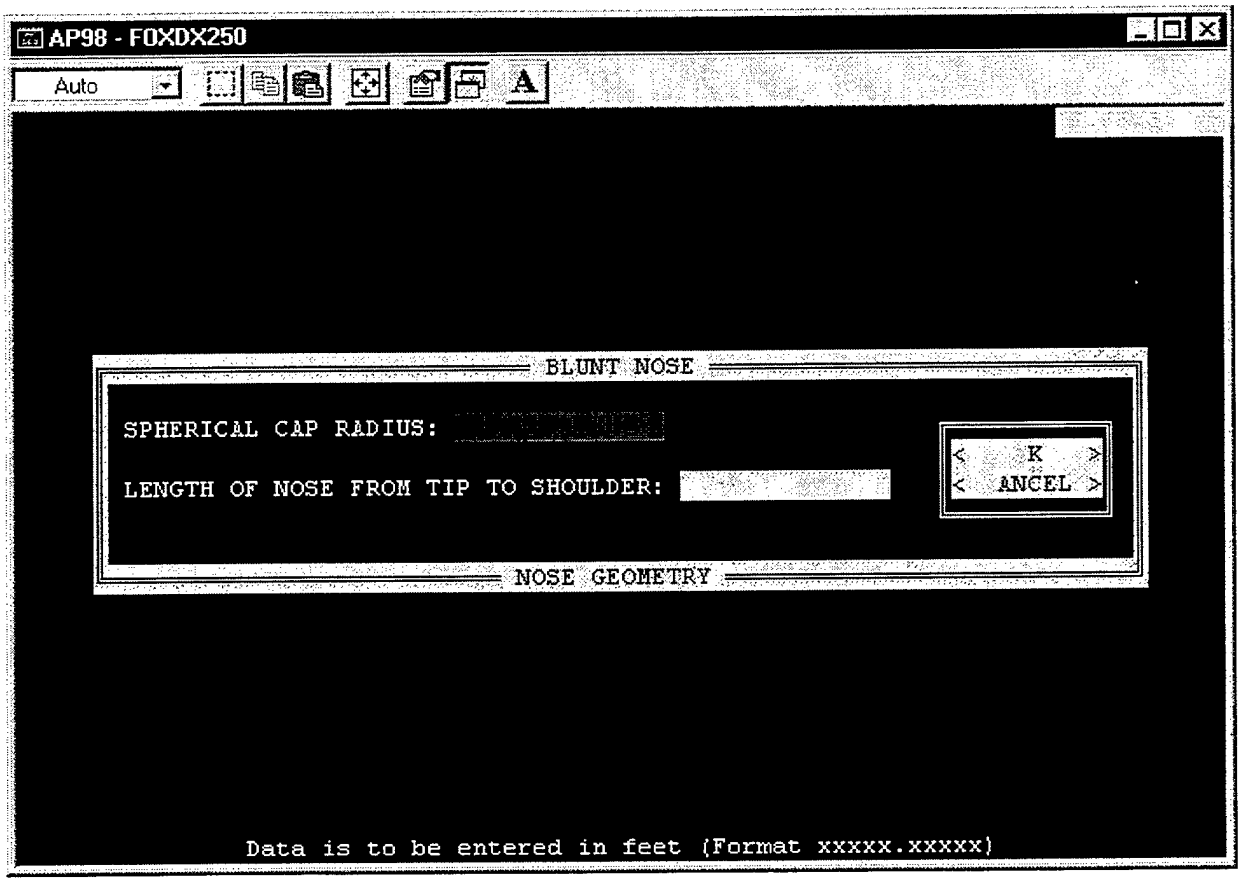


FIGURE 18. EXAMPLE OF NOSE GEOMETRY DATA ENTRY SCREEN

After choosing an option other than "Other" and entering required amplifying data, the AP98 Interface will automatically generate cylindrical coordinate point set pairs associated with a one-sectioned nose that corresponds to the option chosen. Choosing the "Other" popup option will result in the display of the Nose Geometry-Other data entry screen. For a discussion of the Nose Geometry-Other data entry screen, see Section 3.2.2.5.2. (*This data corresponds to AP98 variable **X(I), WMHALF(I)**.*)

TABLE 1. NOSE GEOMETRY DATA TABLE

	Length Of Nose	Spherical Cap Radius	Length Of Nose Prior To Blunting	Nose Tip Radius	Length Of Nose Prior To Truncation	Radius Of Curvature	Cone Half Angle	Power Series Exponent
Tangent Ogive Pointed	✓							
Tangent Ogive Blunt		✓	✓					
Tangent Ogive Truncated				✓	✓			
Von Karman Blunt		✓	✓					
Von Karman Truncated				✓	✓			
Secant Ogive Pointed	✓					✓		
Secant Ogive Blunt		✓	✓			✓		
Secant Ogive Truncated				✓	✓	✓		
Haack Nose Pointed	✓							
Haack Nose Blunt		✓	✓					
Haack Nose Truncated				✓	✓			
Cone Pointed	✓						✓	
Cone Blunt			✓				✓	
Cone Truncated					✓		✓	
Power Series Pointed	✓							✓
Power Series Blunt		✓	✓					✓
Power Series Truncated				✓	✓			✓

OK pushbutton—The OK pushbutton will be enabled after the user has selected both a Nose Cross Sectional Shape popup option and a Nose Profile popup option. By choosing the OK pushbutton, you are confirming that the popup options displayed in the popup controls are correct, and data entry is complete.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Geometry-Nose data entry screen without processing the nose geometry data.

3.2.2.5.2 Nose Geometry-Other Data Entry Screen

The Nose Geometry-Other data entry screen is depicted in Figure 19.

The Nose Geometry-Other data entry screen consists of a set of radio buttons, two popup controls, and four pushbuttons to be used as follows:

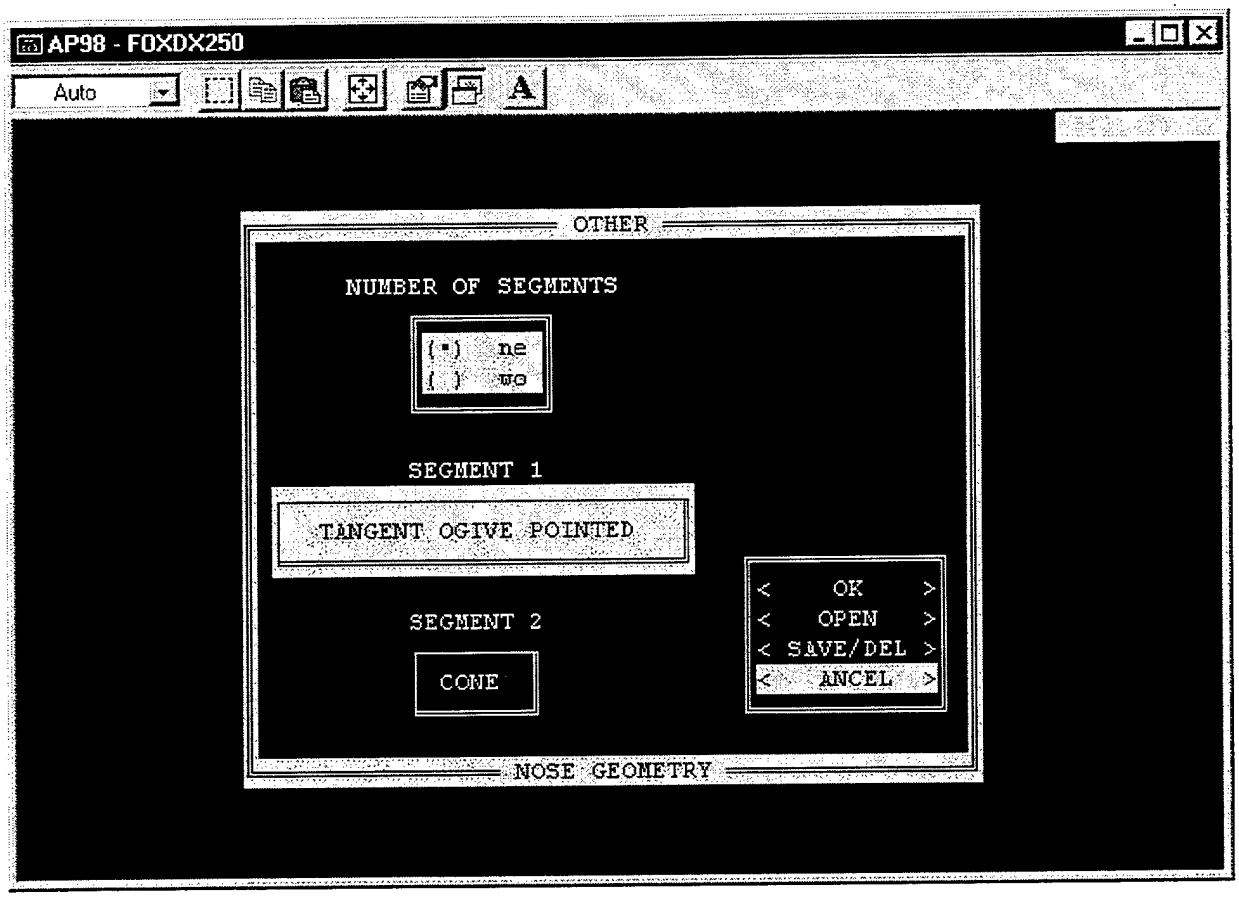


FIGURE 19. NOSE GEOMETRY-OTHER DATA ENTRY SCREEN

Number Of Segments radio button—The Number Of Segments radio button is always enabled. The choice of a Number Of Segments radio button is not mandatory, and the "One" radio button is selected as the default. The nose is allowed to be composed of up to two segments, and the user should choose the radio button that reflects the number of nose segments.

Segment 1 popup control—The Segment 1 popup control is always enabled, and the popup options are the same as those found in the Nose Profile popup control discussed in Section 3.2.2.1, with one exception. The "Other" popup option found in the Nose Profile popup control is replaced with the following three options:

- Other Pointed
- Other Blunt
- Other Truncated

The choice of a Segment 1 popup option is mandatory. Choosing any of the "Other" popup options will result in the display of the Nose Geometry-Nose Segment 1 data entry screen. For a discussion of the Nose Geometry-Nose Segment 1 data entry screen, see Section 3.2.2.5.3. (*This data corresponds to AP98 variables **X(I), WMHALF(I)**.*)

Segment 2 popup control—The Segment 2 popup control will be enabled if the Number Of Segments radio button selected is "TWO." The Segment 2 popup control contains the following options:

- Cone
- Other

The choice of a Segment 2 popup option is mandatory. Choosing the "Cone" popup option will result in the display of the Cone-Nose Segment 2 data entry screen. For a discussion of the Cone-Nose Segment 2 data entry screen, see Section 3.2.2.5.4. The Choice of the "Other" popup option will result in the display of the Nose Geometry-Nose Segment 2 data entry screen. The Nose Geometry-Nose Segment 2 data entry screen is similar to the Nose Geometry-Nose Segment 1 data entry screen in format and function (see Section 3.2.2.5.3). (*This data corresponds to AP98 variables **X(I), WMHALF(I)**.*)

OK pushbutton—The OK pushbutton is not enabled until the user completes the data entry for a Nose Segment 1 option, and a Nose Segment 2 option when the Number Of Segments radio button is "TWO." By choosing the OK pushbutton, you are confirming that the options displayed in the popup controls are correct, and data entry is complete. After choosing the OK pushbutton, the AP98 Interface will automatically generate cylindrical coordinate point set pairs associated with a one- or two-sectioned nose that corresponds to the options chosen and the data entered.

Open pushbutton—The Open pushbutton will be enabled only when there are nose geometry files that have been previously saved by the user. The choice of this pushbutton will result in the display of the Nose Geometry-Open File data entry screen. The user can use the Nose Geometry-Open File data entry screen for opening nose geometry files in exactly the same manner as the Configuration-Open File data entry screen is used for opening aeroprediction configuration files. See Section 3.2.1.1 for a discussion on the use of the Configuration-Open File data entry screen.

Save/Delete pushbutton—The Save/Delete pushbutton will be enabled only when either of the following two conditions are met:

1) The user has completed the data entry for a Nose Segment 1 option, and a Nose Segment 2 option when the Number Of Segments radio button is "TWO."

2) There are nose geometry files that have been previously saved by the user.

The choice of this pushbutton will result in the display of the Nose Geometry-Save/Delete File data entry screen. The user can use the Nose Geometry-Save/Delete File data entry screen for saving and deleting nose geometry files in exactly the same manner as the Configuration-Save/Delete File data entry screen is used for saving and deleting aeroprediction configuration files. See Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Nose Geometry-Other data entry screen without processing the nose geometry data.

3.2.2.5.3 Nose Geometry-Nose Segment 1 Data Entry Screen

The Nose Geometry-Nose Segment 1 data entry screen is depicted in Figure 20.

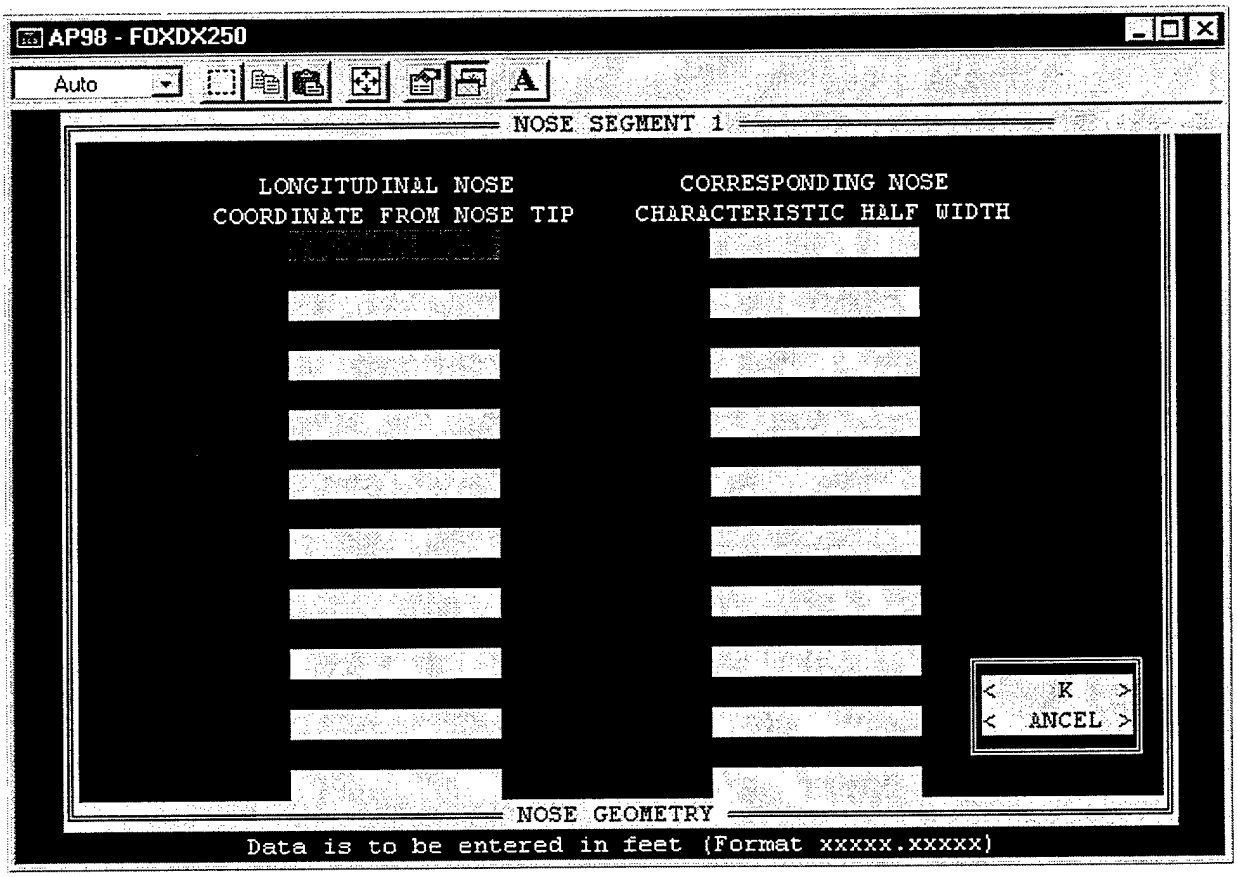


FIGURE 20. NOSE GEOMETRY-NOSE SEGMENT 1 DATA ENTRY SCREEN

The Nose Geometry-Nose Segment 1 data entry screen consists of 20 data fields and two pushbuttons to be used as follows:

Longitudinal Nose Coordinate From Nose Tip and Corresponding Nose Cylindrical Radius data fields—The Longitudinal Nose Coordinate From Nose Tip and Corresponding Nose Cylindrical Radius data fields allow the user to define the cylindrical, coordinate point set pairs associated with the first nose section. These data fields are mandatory, and at least five point set pairs are required. If you entered this data entry screen as a result of choosing the "Other Pointed" popup option, the first point set pair will automatically be set to (0, 0) and will be disabled. If there is only one nose segment, then the last Corresponding Nose Cylindrical Radius data field will be automatically set to either the Circular Radius At End Of Nose value or one half of the Characteristic Blunted Width At End Of Nose value depending upon the type of cross sectional shape selected. Also, the field will be disabled. If there are two nose segments, then the same conditions will be enforced in the Nose Geometry-Nose Segment 2 data entry screen. (*This data corresponds to AP98 variables **X(I)**, **WMHALF(I)**.*)

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Nose Geometry-Nose Segment 1 data entry screen without processing the nose geometry data.

3.2.2.5.4 Cone-Nose Segment 2 Data Entry Screen

The Cone-Nose Segment 2 data entry screen is depicted in Figure 21.

The Cone-Nose Segment 2 data entry screen consists of one data field and two pushbuttons to be used as follows:

Longitudinal Nose Coordinate From Nose Tip data field—The Longitudinal Nose Coordinate From Nose Tip data field allows the user to define the cylindrical coordinate point set pair necessary to define the second nose section as a conical frustum. Note that the entry of a corresponding nose cylindrical radius is not required. It will be automatically set to either the Circular Radius At End Of Nose value or one half of the Characteristic Blunted Width At End Of Nose value depending upon the type of cross sectional shape selected. The entry of data into the Longitudinal Nose Coordinate From Nose Tip data field is mandatory. (*This data corresponds to AP98 variables **X(I)**, **WMHALF(I)**.*)

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK push-button, you are confirming that data entry is complete. After choosing the OK push-button, the AP98 Interface will determine if all mandatory data items have been entered.

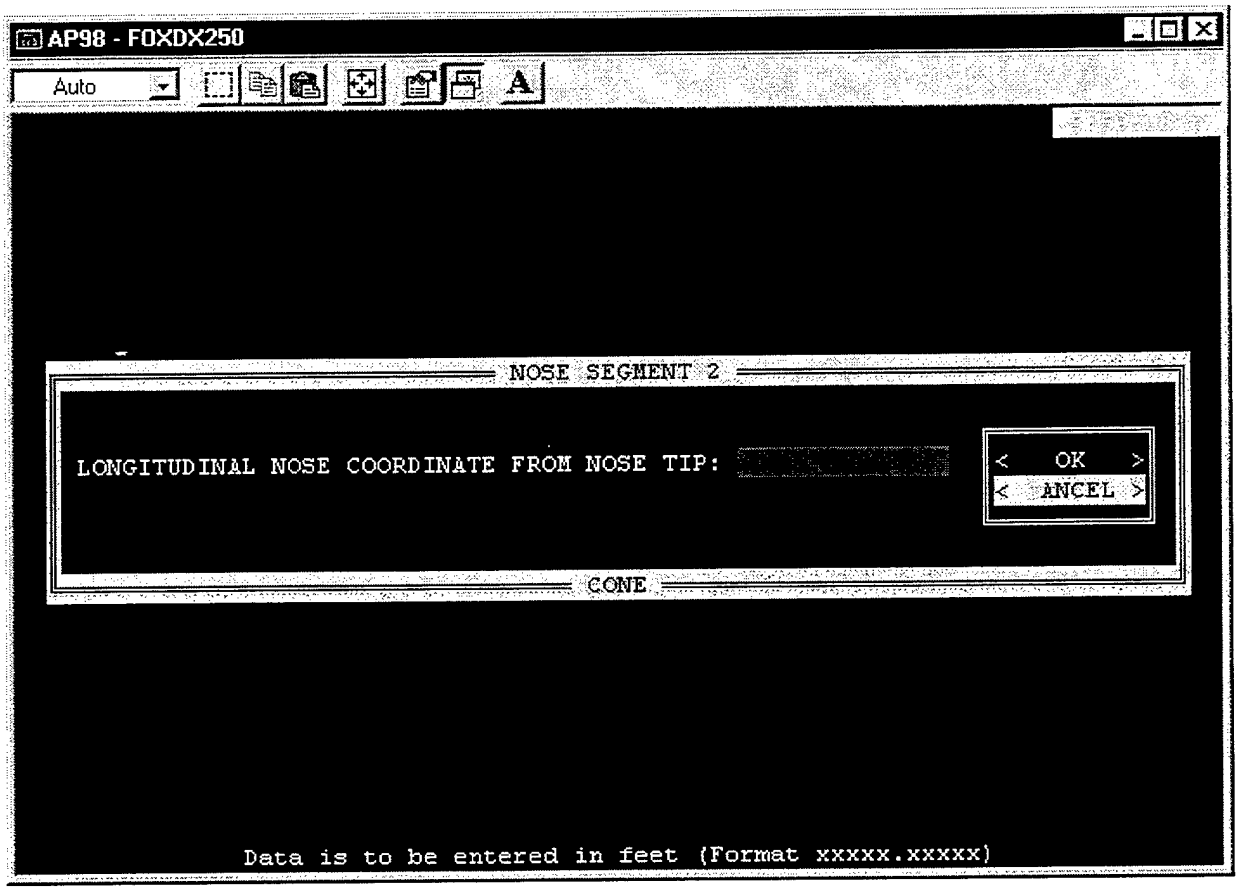


FIGURE 21. CONE-NOSE SEGMENT 2 DATA ENTRY SCREEN

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Cone-Nose Segment 2 data entry screen without processing the nose geometry data.

3.2.2.6 Afterbody Geometry Data Entry Screens

3.2.2.6.1 Geometry-Afterbody Data Entry Screen

The Geometry-Afterbody data entry screen is depicted in Figure 22. This data entry screen provides the user the means in which to describe the geometry of the afterbody of a missile. It consists of two popup controls, three pushbuttons, and four data fields to be used as follows:

Afterbody Cross Sectional Shape popup control—The Afterbody Cross Sectional Shape popup control is always enabled and contains the following Nose Cross Sectional Shape popup options:

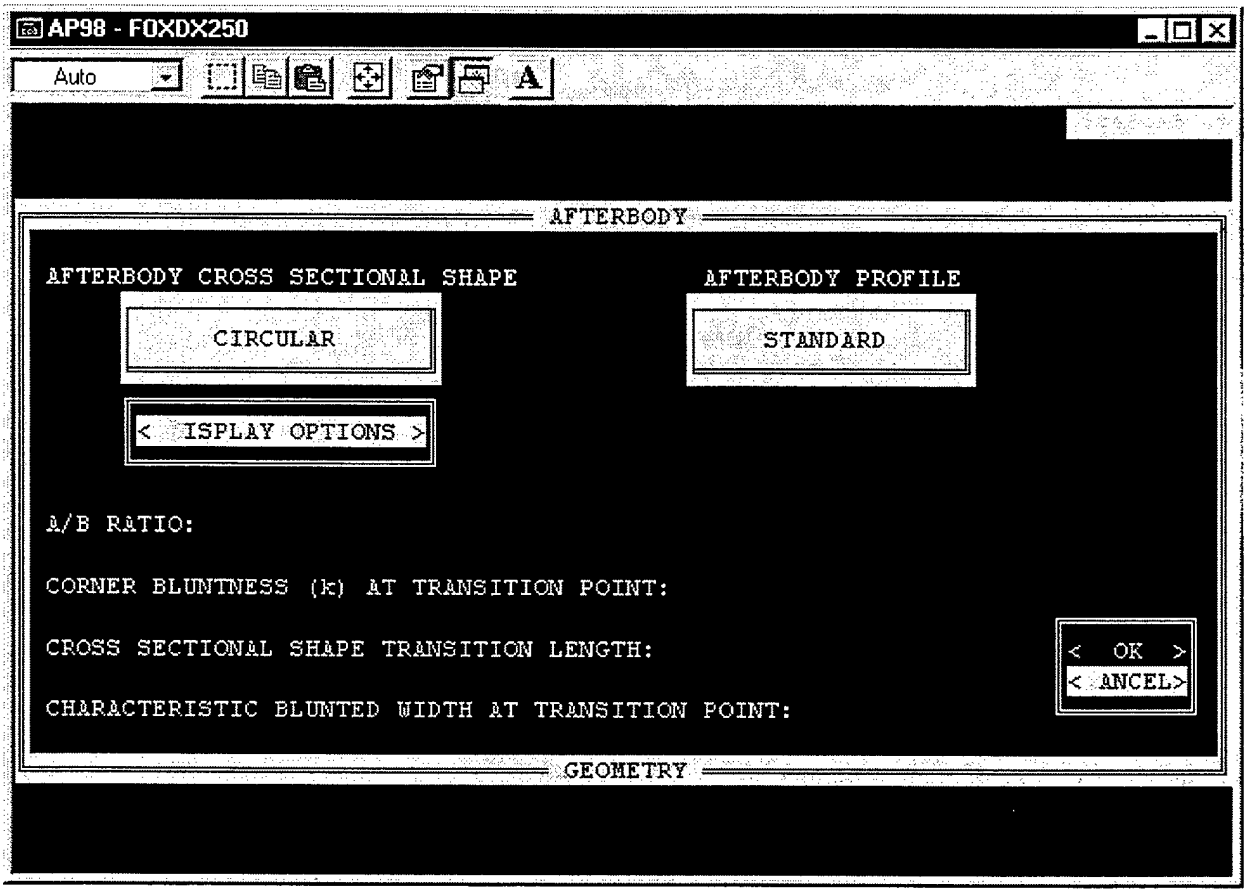


FIGURE 22. GEOMETRY-AFTERBODY DATA ENTRY SCREEN

- Circular
- Elliptical
- Square
- Diamond
- Triangle
- Inverted Triangle
- None

The user should choose that menu option which best represents the cross-sectional shape at the end of the afterbody. If there is no afterbody, then the "None" option should be chosen. The choice of an Afterbody Cross Sectional Shape menu option is mandatory,

and the default option is "Circular." (*This data corresponds to AP98 variable **ICROSS(2)**.*)

Display Options pushbutton—See the discussion of the Display Options pushbuttons in Section 3.2.2.5.1.

A/B Ratio data field—The A/B Ratio data field will be enabled when the "Elliptical" popup option has been chosen from the Afterbody Cross Sectional Shape popup menu. When enabled, the entry of data into this data field is mandatory. (*This data corresponds to AP98 variable **AOVERB(2)**.*)

Corner Bluntness (k) At Transition Point data field—The Corner Bluntness (k) At Transition Point will be enabled when the "Square," "Diamond," "Triangle," or "Inverted Triangle" popup option has been chosen from the Afterbody Cross Sectional Shape popup menu. When enabled, the entry of data into this data field is mandatory. (*This data corresponds to AP98 variable **CORK(2)**.*)

Afterbody Profile popup control—The Afterbody Profile popup control is always enabled unless the Afterbody Cross Sectional Shape popup selection is "None." The following Afterbody popup options are available when both the Afterbody Cross Sectional Shape and Nose Cross Sectional Shape option selections are "Circular":

- Standard
- Other

If either the Afterbody Cross Sectional Shape or Nose Cross Sectional Shape option selections are noncircular, then only the "Standard" option will be available. The choice of an Afterbody popup option is mandatory. Choosing the "Standard" option will result in the display of the Afterbody Geometry-Standard data entry screen. For a discussion of the Afterbody Geometry-Standard data entry screen, see Section 3.2.2.6.2. Choosing the "Other" option will result in the display of the Afterbody Geometry-Other data entry screen. For a discussion of the Afterbody Geometry-Other data entry screen, see Section 3.2.2.6.3. (*This data corresponds to AP98 variables **X(I), WMHALF(I)**.*)

Cross Sectional Shape Transition Length data field—Initially disabled, the Cross Sectional Shape Transition Length data field is either enabled or will remain disabled, depending upon the user's description of the cross-sectional shapes entered at the end of the nose and at the end of the afterbody. The data field remains disabled only when the cross-sectional shape at the end of the nose and the cross-sectional shape at the end of the afterbody are identical in every respect. Otherwise, the data field will be enabled upon completion of the Afterbody Profile popup control inputs. Entry of data into the Cross Sectional Shape Transition Length data field is mandatory. The value entered into the field determines the distance over which the cross-sectional shape at the end of the nose fully transitions into the cross-sectional shape at the transition point. The value entered

into the field is also checked for validity before the user leaves the Geometry-Afterbody data entry screen. (*This data corresponds to AP98 variable **TRNLEN**.*)

Characteristic Blunted Width At Transition Point data field—This data field will become enabled only when the Cross Sectional Shape Transition Length data field is enabled. The entry of data into the Characteristic Blunted Width At Transition Point data field is mandatory. The value entered into the data field should be equal to the circular diameter for circular cross sections or the characteristic blunted width for non-circular cross sections. (*This data corresponds to AP98 variable **WMHALF*2**.*)

3.2.2.6.2 Afterbody Geometry-Standard Data Entry Screen

The Afterbody Geometry-Standard data entry screen is depicted in Figure 23.

The Afterbody Geometry-Standard data entry screen consists of one data field and two pushbuttons to be used as follows:

Longitudinal Afterbody Coordinate From Nose Tip data field—The Longitudinal Afterbody Coordinate From Nose Tip data fields allow the user to define the cylindrical coordinate point set pair necessary to define a one-sectioned, right circular cylinder afterbody. Physically, this point set pair is located near the end of the missile, not near the nose. (See Figure 47 in the Geometry Reference in the Appendix.) Note that the entry of a corresponding afterbody cylindrical radius is not required. It will be automatically set to either the Circular Radius At End Of Nose value or one half of the Characteristic Blunted Width At End Of Nose value depending upon the type of cross sectional shape selected for the nose. The entry of data into the Longitudinal Afterbody Coordinate From Nose Tip data field is mandatory. (*This data corresponds to AP98 variables **X(I)**, **WMHALF(I)**.*)

OK pushbutton—The OK pushbutton will be enabled after the user has selected an Afterbody Cross Sectional Shape popup option and an Afterbody Profile popup option. By choosing the OK pushbutton, you are confirming that the popup options displayed in the popup controls are correct, and data entry is complete.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Afterbody Geometry-Standard data entry screen without processing the afterbody geometry data.

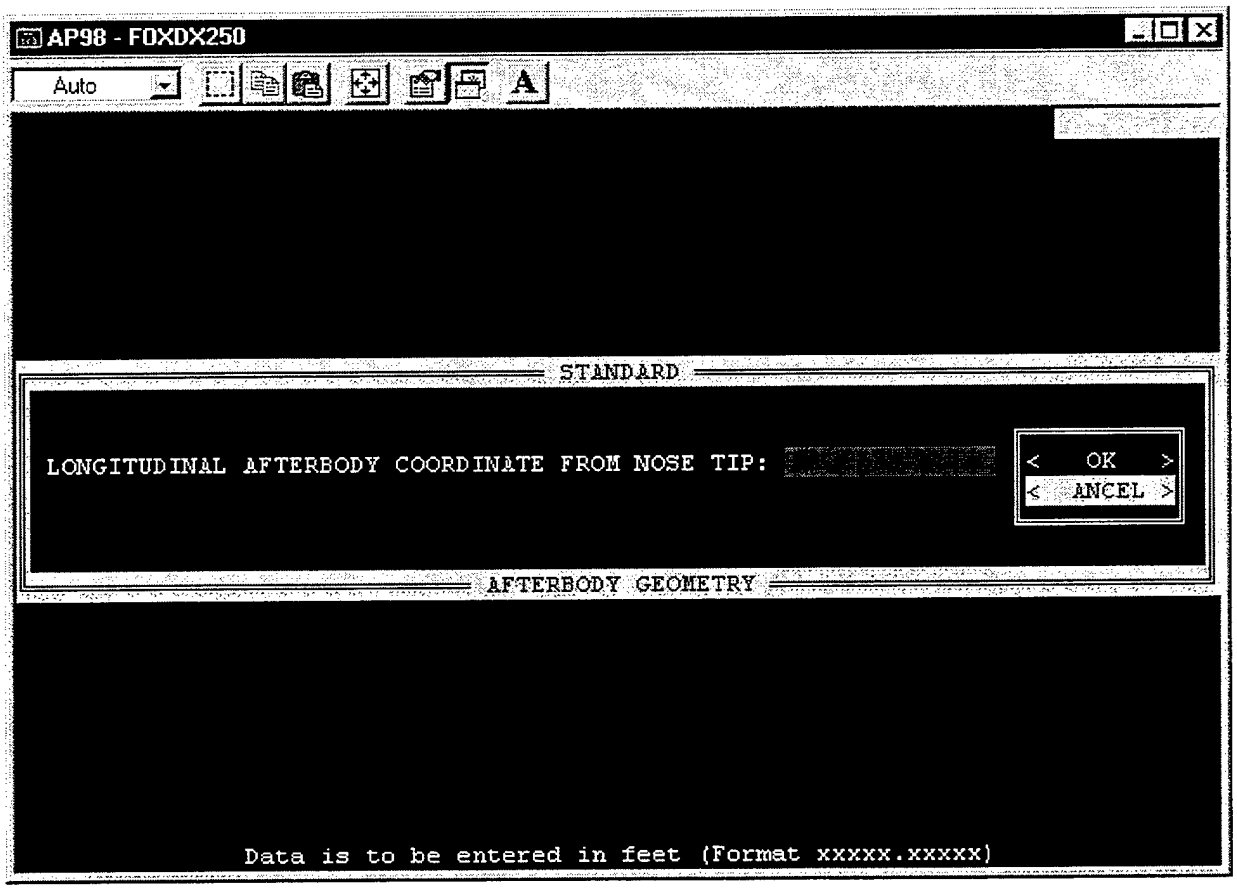


FIGURE 23. AFTERBODY GEOMETRY-STANDARD DATA ENTRY SCREEN

3.2.2.6.3 Afterbody Geometry-Other Data Entry Screen

The Afterbody Geometry-Other data entry screen is depicted in Figure 24.

The Afterbody Geometry-Other data entry screen consists of a set of radio buttons and four pushbuttons to be used as follows:

Number Of Afterbody Segments radio buttons—The Number Of Afterbody Segments radio buttons are used to designate the number of sections in the afterbody. The choice of a radio button is mandatory. Choosing a Number Of Afterbody Segments radio button will result in the display of successive Afterbody Geometry-Afterbody Segment data entry screens. The number of data entry screens that will be displayed is equal to the number of afterbody segments that you designate. Each of the Afterbody Geometry-Afterbody Segment data entry screens are similar in format and function. For a discussion of the Afterbody Geometry-Afterbody Segment 1 data entry screen, see Section 3.2.2.6.3.1. (*This data corresponds to AP98 variable **NH-2**.*)

FIGURE 24. AFTERBODY GEOMETRY-OTHER DATA ENTRY SCREEN

OK pushbutton—The OK pushbutton is not enabled until the user has completed entering data for all of the designated afterbody segments via the Afterbody Geometry-Afterbody Segment data entry screens.

Open pushbutton—The Open pushbutton will be enabled only when there are afterbody geometry files that have been previously saved by the user. The choice of this pushbutton will result in the display of the Afterbody Geometry-Open File data entry screen. The user can use the Afterbody Geometry-Open File data entry screen for opening afterbody geometry files in exactly the same manner as the Configuration-Open File data entry screen is used for opening aeroprediction configuration files. See Section 3.2.1.1 for a discussion on the use of the Configuration-Open File data entry screen.

Save/Delete pushbutton—The Save/Delete pushbutton will be enabled only when either of the following two conditions are met:

1) The user has completed the data entry for all of the designated afterbody segments.

2) There are afterbody geometry files that have been previously saved by the user.

The choice of this pushbutton will result in the display of the Afterbody Geometry-Save/Delete File data entry screen. The user can use the Afterbody Geometry-Save/Delete File data entry screen for saving and deleting afterbody geometry files in exactly the same manner as the Configuration-Save/Delete File data entry screen is used for saving and deleting aeroprediction configuration files. See Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Afterbody Geometry-Other data entry screen without processing the afterbody geometry data.

3.2.2.6.3.1 Afterbody Geometry-Afterbody Segment 1 Data Entry Screen. The Afterbody Geometry-Afterbody Segment 1 data entry screen is depicted in Figure 25.

The Afterbody Geometry-Afterbody Segment 1 data entry screen consists of 20 data fields and two pushbuttons to be used as follows:

Longitudinal Afterbody Coordinate From Nose Tip and Corresponding Afterbody Cylindrical Radius data fields—The Longitudinal Afterbody Coordinate From Nose Tip and Corresponding Afterbody Cylindrical Radius data fields allow the user to define the cylindrical coordinate point set pairs associated with the first afterbody section. These data fields are mandatory, and at least five point set pairs are required. (*This data corresponds to AP98 variables* ***X(I), WMHALF(I)***.)

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Afterbody Geometry-Afterbody Segment 1 data entry screen without processing the afterbody geometry data.

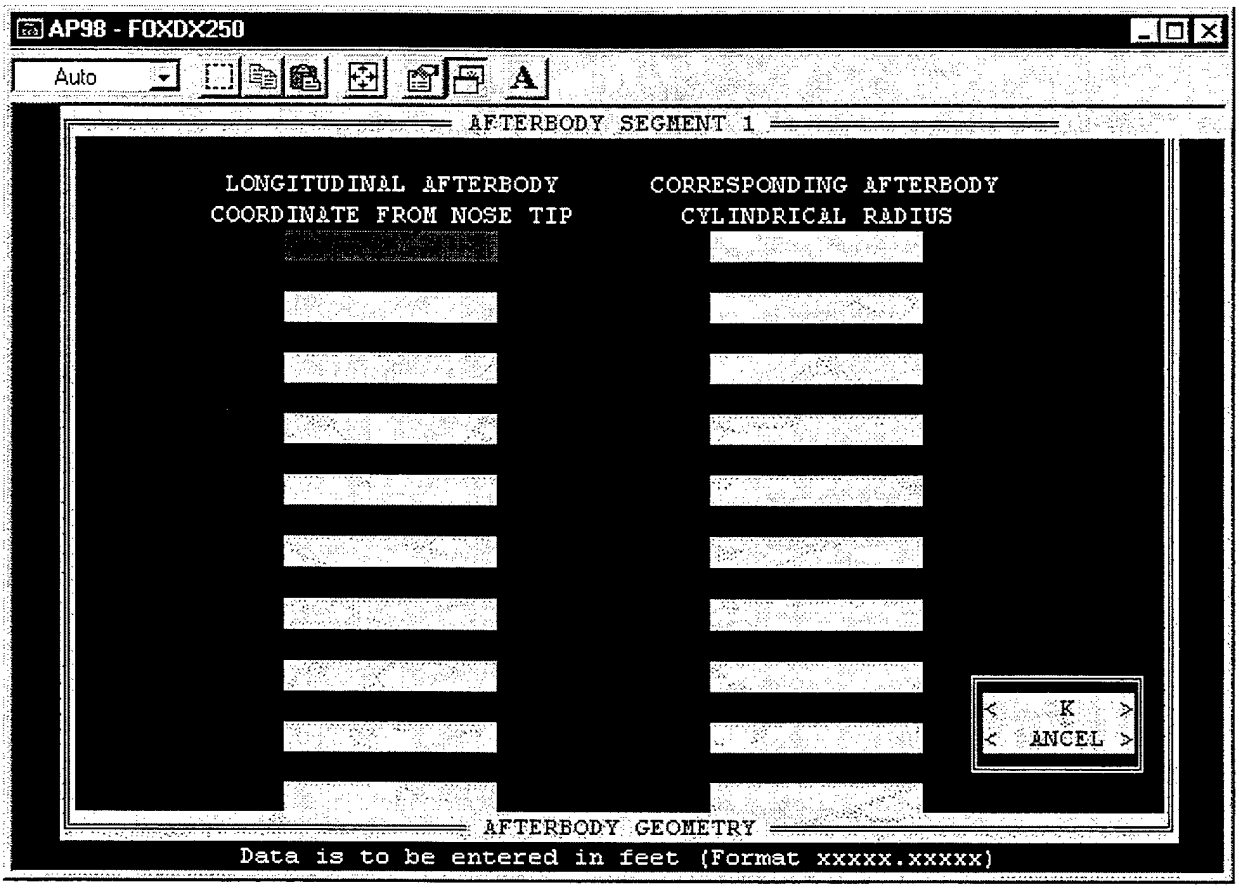


FIGURE 25. AFTERBODY GEOMETRY-AFTERBODY SEGMENT 1 DATA ENTRY SCREEN

3.2.2.6.4 Afterbody Geometry-Boattail/Flare Data Entry Screen

The Afterbody Geometry-Boattail/Flare data entry screen is depicted in Figure 26.

The Afterbody Geometry-Boattail/Flare data entry screen consists of two data fields and two pushbuttons to be used as follows:

Longitudinal Boattail/Flare Coordinate From Nose Tip and **Corresponding Boattail/Flare Cylindrical Radius** data fields - The Longitudinal Boattail/Flare Coordinate From Nose Tip and Corresponding Boattail/Flare Cylindrical Radius data fields allow the user to define the cylindrical coordinate point set pair necessary to define a boattail/flare. The entry of a point set pair is mandatory. (*This data corresponds to AP98 variables **X(I)**, **WMHALF(I)**.*)

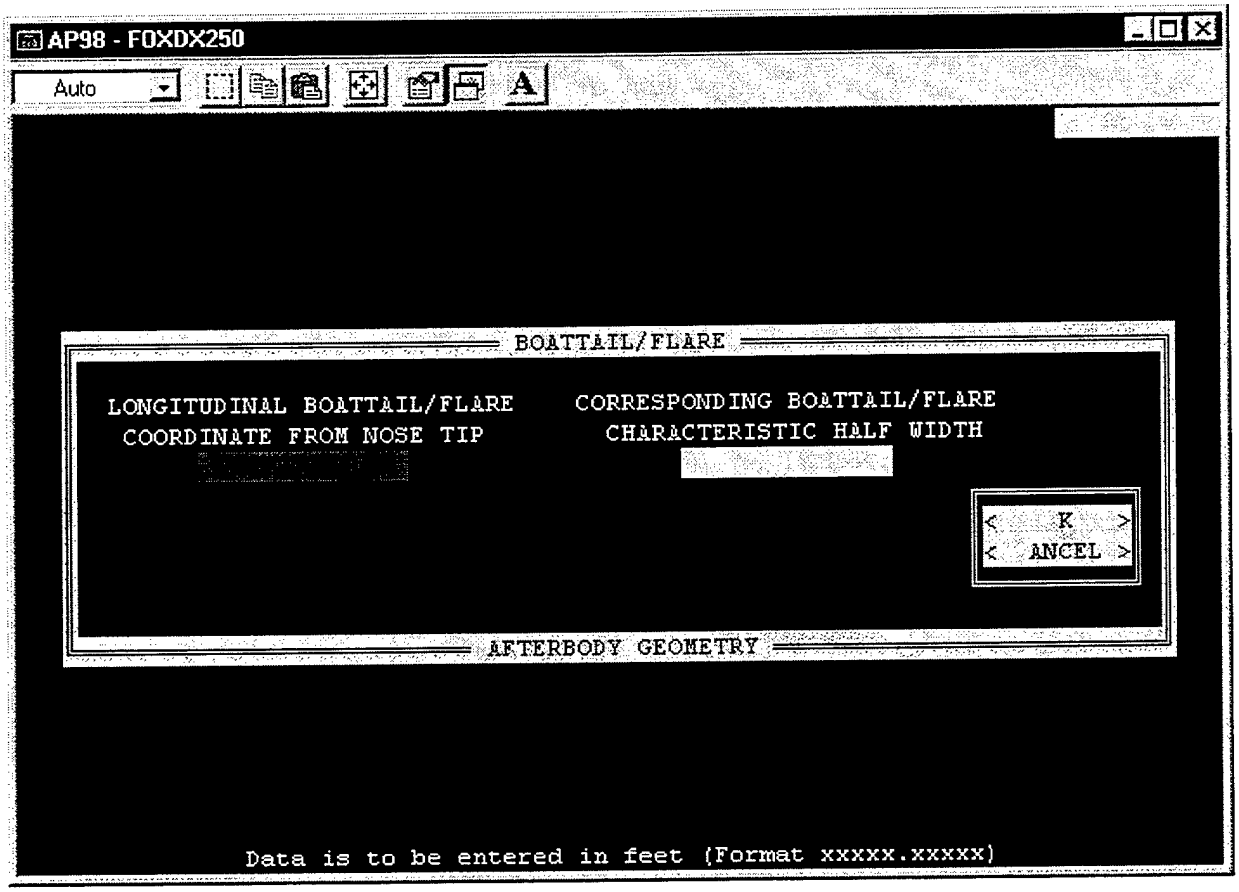


FIGURE 26. AFTERBODY GEOMETRY-BOATTAIL/FLARE DATA ENTRY SCREEN

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Afterbody Geometry-Boattail/Flare data entry screen without processing the boattail/flare geometry data.

3.2.2.7 Tail Geometry Data Entry Screens

3.2.2.7.1 Tail Geometry-Double-Wedge Airfoil Data Entry Screen

The Tail Geometry-Double-Wedge Airfoil data entry screen is depicted in Figure 27.

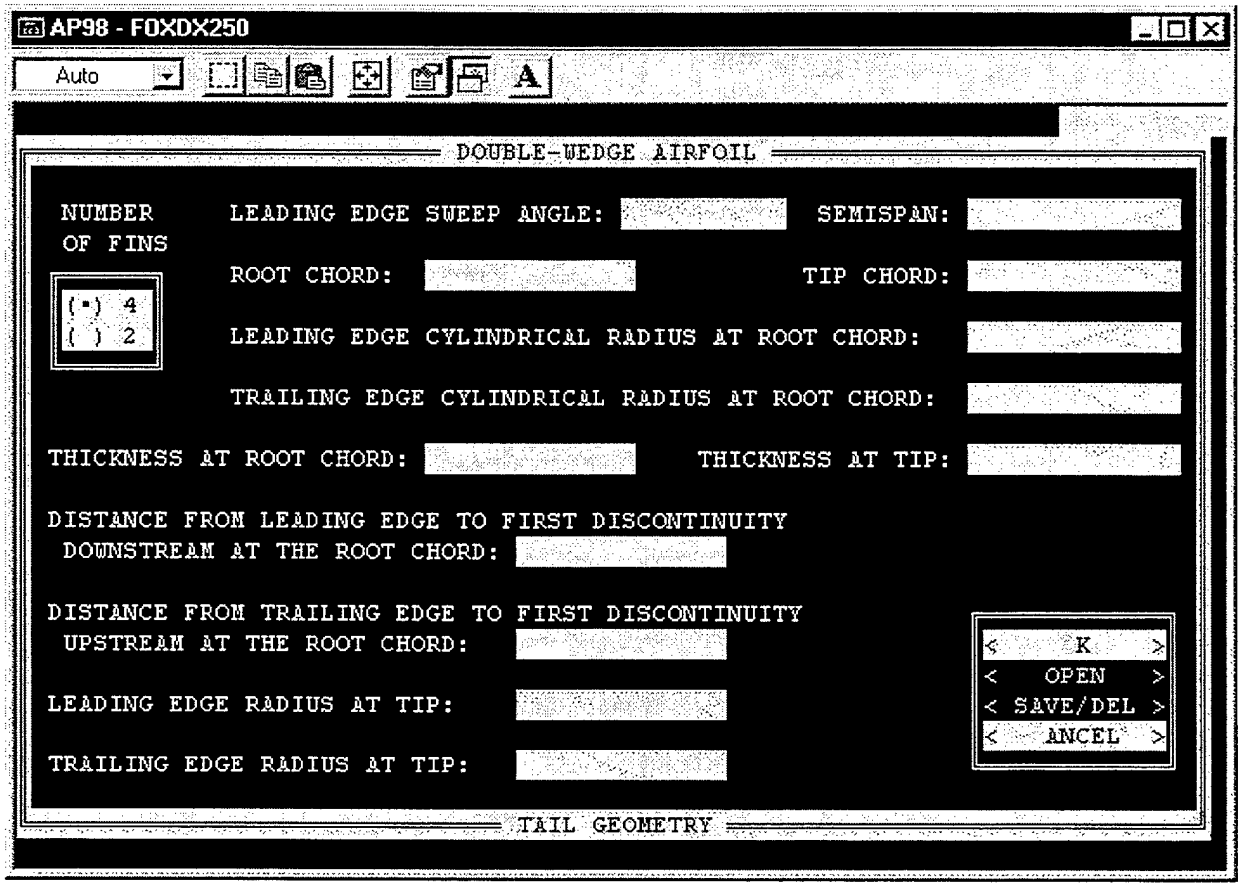


FIGURE 27. TAIL GEOMETRY-DOUBLE-WEDGE AIRFOIL DATA ENTRY SCREEN

The Tail Geometry-Double-Wedge Airfoil data entry screen consists of a set of radio buttons, 12 data fields and four pushbuttons to be used as follows:

Number Of Fins radio buttons—The Number Of Fins radio buttons are used to designate the number of fins on the tail. The choice of a radio button is not mandatory. The default is four fins. (*This data corresponds to AP98 variable **NW**.*)

Leading Edge Sweep Angle data field—The entry of data into the Leading Edge Sweep Angle data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **GAW(1)**.*)

Semispan data field—The entry of data into the Semispan data field is mandatory. (*This data corresponds to AP98 variable **BW/2**.*)

Root Chord data field—The entry of data into the Root Chord data field is mandatory. (*This data corresponds to AP98 variable **CRW**.*)

Tip Chord data field—The entry of data into the Tip Chord data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **CTW**.*)

Leading Edge Cylindrical Radius At Root Chord data field—The entry of data into the Leading Edge Cylindrical Radius At Root Chord data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **RRW**.*)

Trailing Edge Cylindrical Radius At Root Chord data field—The entry of data into the Trailing Edge Cylindrical Radius At Root Chord data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **RTEW**.*)

Thickness At Root Chord data field—The entry of data into the Thickness At Root Chord data field is mandatory and is initialized to five one-hundredths (0.05) of the value entered for the Root Chord. (*This data corresponds to AP98 variable **TRW**.*)

Thickness At Tip Chord data field—The entry of data into the Thickness At Tip Chord data field is mandatory, and is initialized to five one-hundredths (0.05) of the value entered for the Tip Chord. (*This data corresponds to AP98 variable **TTW**.*)

Distance From Leading Edge To First Discontinuity Downstream At The Root Chord data field—The entry of data into the Distance From Leading Edge To First Discontinuity Downstream At The Root Chord data field is mandatory. (*This data corresponds to AP98 variable **CR1W**.*)

Distance From Trailing Edge To First Discontinuity Upstream At The Root Chord data field—The entry of data into the Distance From Leading Edge To First Discontinuity Upstream At The Root Chord data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **CR2W**.*)

Leading Edge Radius At Tip data field—The entry of data into the Leading Edge Radius At Tip data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **RTW**.*)

Trailing Edge Radius At Tip data field—The entry of data into the Trailing Edge Radius At Tip data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **RTEW1**.*)

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Open pushbutton—The Open pushbutton will be enabled only when there are tail geometry-double-wedge airfoil files that have been previously saved by the user. The choice of this pushbutton will result in the display of the Tail Geometry-Open File data

entry screen. The user can use the Tail Geometry-Open File data entry screen for opening tail geometry-double-wedge airfoil files in exactly the same manner as the Configuration-Open File data entry screen is used for opening aeroprediction configuration files. See Section 3.2.1.1 for a discussion on the use of the Configuration-Open File data entry screen.

Save/Delete pushbutton—The Save/Delete pushbutton will be enabled only when either of the following two conditions are met:

1) The user has completed the data entry for the mandatory data fields.

2) There are tail geometry-double-wedge airfoil files that have been previously saved by the user.

The choice of this pushbutton will result in the display of the Tail Geometry-Save/Delete File data entry screen. The user can use the Tail Geometry-Save/Delete File data entry screen for saving and deleting tail geometry-double-wedge airfoil files in exactly the same manner as the Configuration-Save/Delete File data entry screen is used for saving and deleting aeroprediction configuration files. See Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Tail Geometry-Double-Wedge Airfoil data entry screen without processing the tail geometry-double-wedge airfoil data.

3.2.2.7.2 Tail Geometry-Biconvex Airfoil Data Entry Screen

The Tail Geometry-Biconvex Airfoil data entry screen is depicted in Figure 28.

The Tail Geometry-Biconvex Airfoil data entry screen consists of a set of radio buttons, seven data fields and four pushbuttons to be used as follows:

Number Of Fins radio buttons—See the discussion of the Number Of Fins radio buttons in Section 3.2.2.7.1.

Leading Edge Sweep Angle data field—See the discussion of the Leading Edge Sweep Angle data field in Section 3.2.2.7.1.

Semispan data field—See the discussion of the Semispan data field in Section 3.2.2.7.1.

Root Chord data field—See the discussion of the Root Chord data field in Section 3.2.2.7.1.

Tip Chord data field—See the discussion of the Tip Chord data field in Section 3.2.2.7.1.

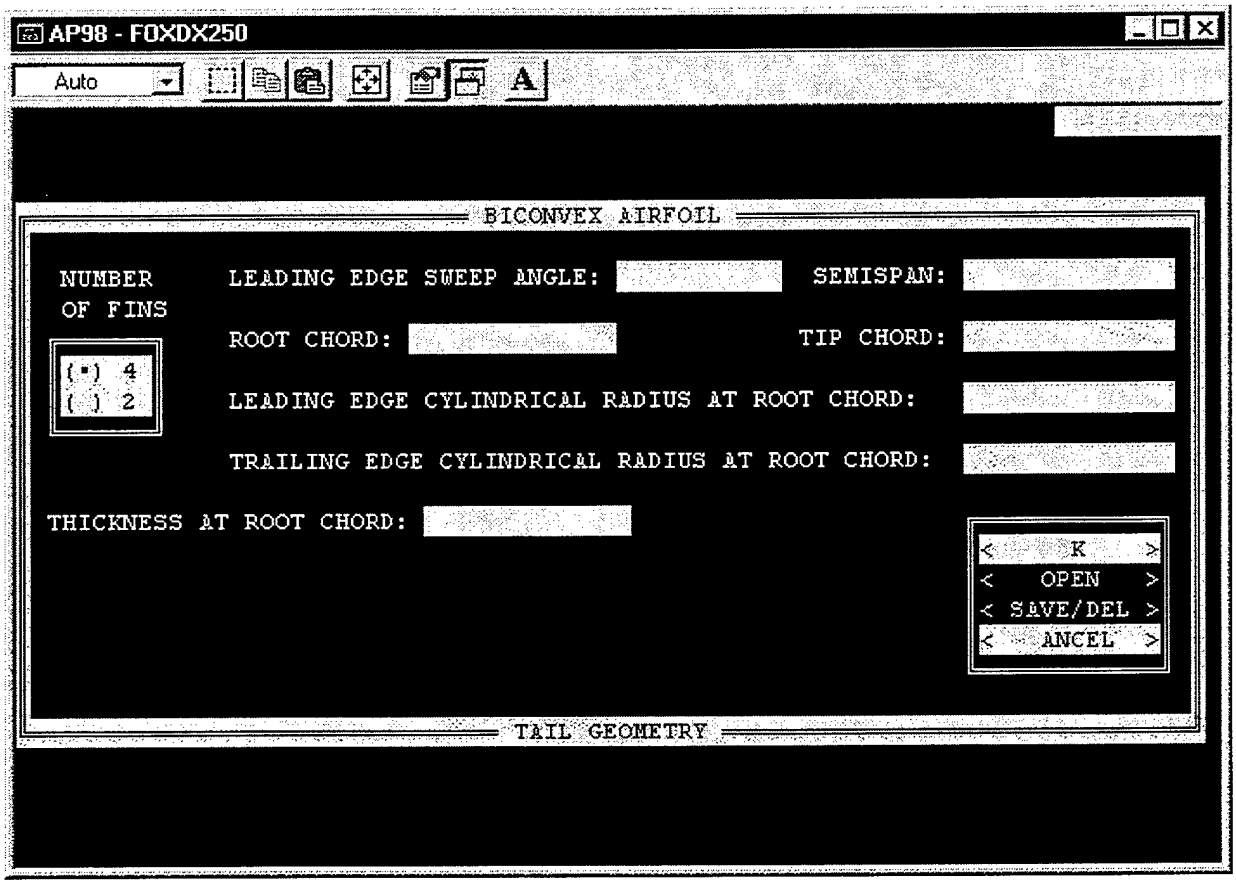


FIGURE 28. TAIL GEOMETRY-BICONVEX AIRFOIL DATA ENTRY SCREEN

Leading Edge Cylindrical Radius At Root Chord data field—See the discussion of the Leading Edge Cylindrical Radius At Root Chord data field in Section 3.2.2.7.1.

Trailing Edge Cylindrical Radius At Root Chord data field—See the discussion of the Trailing Edge Cylindrical Radius At Root Chord data field in Section 3.2.2.7.1.

Thickness At Root Chord data field—See the discussion of the Thickness At Root Chord data field in Section 3.2.2.7.1.

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Open pushbutton—The Open pushbutton will be enabled only when there are tail geometry-biconvex airfoil files that have been previously saved by the user. The choice of this pushbutton will result in the display of the Tail Geometry-Open File data entry

screen. The user can use the Tail Geometry-Open File data entry screen for opening tail geometry-biconvex airfoil files in exactly the same manner as the Configuration-Open File data entry screen is used for opening aeroprediction configuration files. See Section 3.2.1.1 for a discussion on the use of the Configuration-Open File data entry screen.

Save/Delete pushbutton—The Save/Delete pushbutton will be enabled only when either of the following two conditions are met:

1) The user has completed the data entry for the mandatory data fields.

2) There are tail geometry-double-wedge airfoil files that have been previously saved by the user.

The choice of this pushbutton will result in the display of the Tail Geometry-Save/Delete File data entry screen. The user can use the Tail Geometry-Save/Delete File data entry screen for saving and deleting tail geometry-biconvex airfoil files in exactly the same manner as the Configuration-Save/Delete File data entry screen is used for saving and deleting aeroprediction configuration files. See Section 3.2.1.2 for a discussion on the use of the Configuration-Save/Delete File data entry screen.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Tail Geometry-Biconvex Airfoil data entry screen without processing the tail geometry-biconvex airfoil data.

3.2.2.7.3 Tail Geometry-Alter Planform Data Entry Screen

The Tail Geometry-Alter Planform data entry screen is depicted in Figure 29.

The Tail Geometry-Alter Planform data entry screen consists of two data field arrays, five data fields, six pushbuttons, and a set of radio buttons to be used as follows:

Planform X,Y Coordinates data field arrays—The Planform X,Y Coordinates data field arrays are always enabled. The user should use these data field arrays to describe the planform shape of the lifting surface. The first point is automatically set to 0,0 and is disabled. It represents the origin of a coordinate system that is located where the leading edge meets the missile body. The user should enter an X,Y coordinate pair corresponding to each discontinuity encountered in the outline of the planform shape as it is traversed in a clockwise fashion. (See appendix ? for a discussion on the Alter Planform Utility). The X coordinates are to be placed in the leftmost data field array, and the Y coordinates are to be placed in the rightmost data field array. Entry of data into the Planform X,Y Coordinates data field arrays is mandatory.

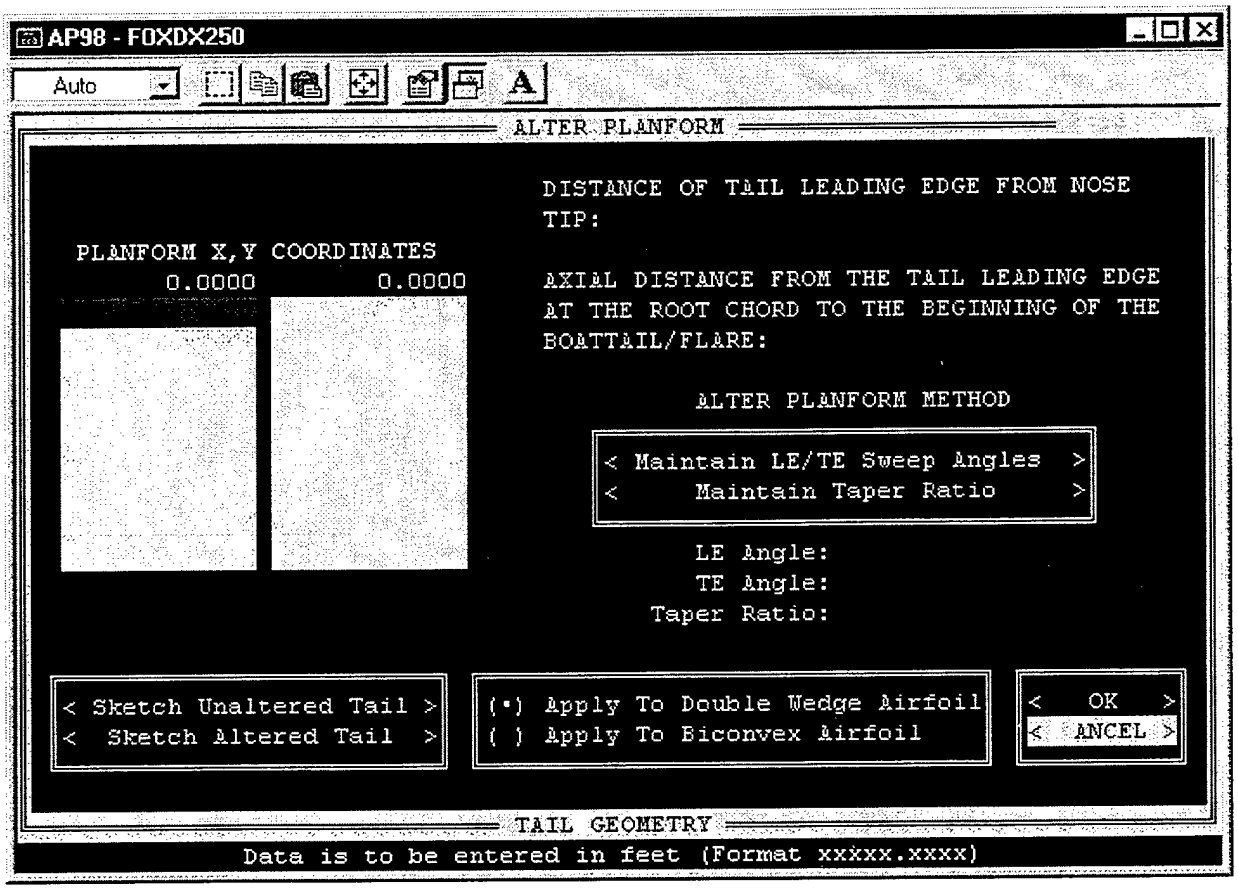


FIGURE 29. TAIL GEOMETRY-ALTER PLANFORM DATA ENTRY SCREEN

Distance Of Tail Leading Edge From Nose Tip data field—The Distance Of Tail Leading Edge From Nose Tip data field will become enabled after a minimum of three X,Y coordinate points have been entered into the Planform X,Y Coordinates data field arrays. Note that a minimum of three X,Y coordinate points are required to define a planform shape. The entry of data into the Distance Of Tail Leading Edge From Nose Tip data field is mandatory.

Axial Distance From The Tail Leading Edge At The Root Chord To The Beginning Of The Boattail/Flare data field—Two conditions are required to be met before the Axial Distance From The Tail Leading Edge At The Root Chord To The Beginning Of The Boattail/Flare data field will be enabled. The first condition is that a minimum of three X,Y coordinate points must be entered into the Planform X,Y Coordinates data field arrays. The second condition is that the last Y coordinate is non-zero, indicating the presence of a Boattail/Flare. Entry of data into the Axial Distance From The Tail Leading Edge At The Root Chord To The Beginning Of The Boattail/Flare data field is mandatory when the last Y coordinate is non-zero.

Maintain LE/TE Sweep Angles pushbutton—The Maintain LE/TE Sweep Angles pushbutton will become enabled after a minimum of three X,Y coordinate points have been entered into the Planform X,Y Coordinates data field arrays. Selection of this pushbutton will conserve the leading and trailing edge sweep angles when the planform is altered. (See Section 4.5 for a discussion on the Alter Planform Utility).

Maintain Taper Ratio pushbutton—The Maintain Taper Ratio pushbutton will become enabled after a minimum of three X,Y coordinate points have been entered into the Planform X,Y Coordinates data field arrays. Selection of this pushbutton will conserve the taper ratio when the planform is altered. (See Section 4.5 for a discussion on the Alter Planform Utility).

LE Angle data field—The LE Angle data field is enabled when either the Maintain LE/TE Sweep Angles or the Maintain Taper Ratio pushbuttons is selected. The data field will initially contain a value for the planform leading edge sweep angle based upon the X,Y coordinate points entered by the user into the Planform X,Y Coordinates data field arrays. The user may change this value.

TE Angle data field—The TE Angle data field is enabled when the Maintain LE/TE Sweep Angles pushbutton is selected. The data field will initially contain a value for the planform trailing edge sweep angle based upon the X,Y coordinate points entered by the user into the Planform X,Y Coordinates data field arrays. The user may change this value.

Taper Ratio data field—The Taper Ratio data field is enabled when the Maintain Taper Ratio pushbutton is selected. The user should enter a value for the taper ratio, which is to be conserved during the Alter Planform process. (See Section 4.5 for a discussion on the Alter Planform Utility).

Sketch Unaltered Tail pushbutton—The Sketch Unaltered Tail pushbutton will become enabled after a minimum of three X,Y coordinate points have been entered into the Planform X,Y Coordinates data field arrays and the last Y coordinate entered is zero. The Sketch Unaltered Tail pushbutton will also become enabled after: a minimum of three X,Y coordinate points have been entered into the Planform X,Y Coordinates data field arrays, the last Y coordinate entered is non-zero, and data has been entered into the Axial Distance From The Tail Leading Edge At The Root Chord To The Beginning Of The Boattail/Flare data field. Upon choosing the Sketch Unaltered Tail pushbutton, a sketch of the unaltered lifting surface planform will be displayed on the screen. An example of a sketch is given in Figure 30. Hitting any key on the keyboard will remove the sketch and return the user to the Tail Geometry-Alter Planform data entry screen.

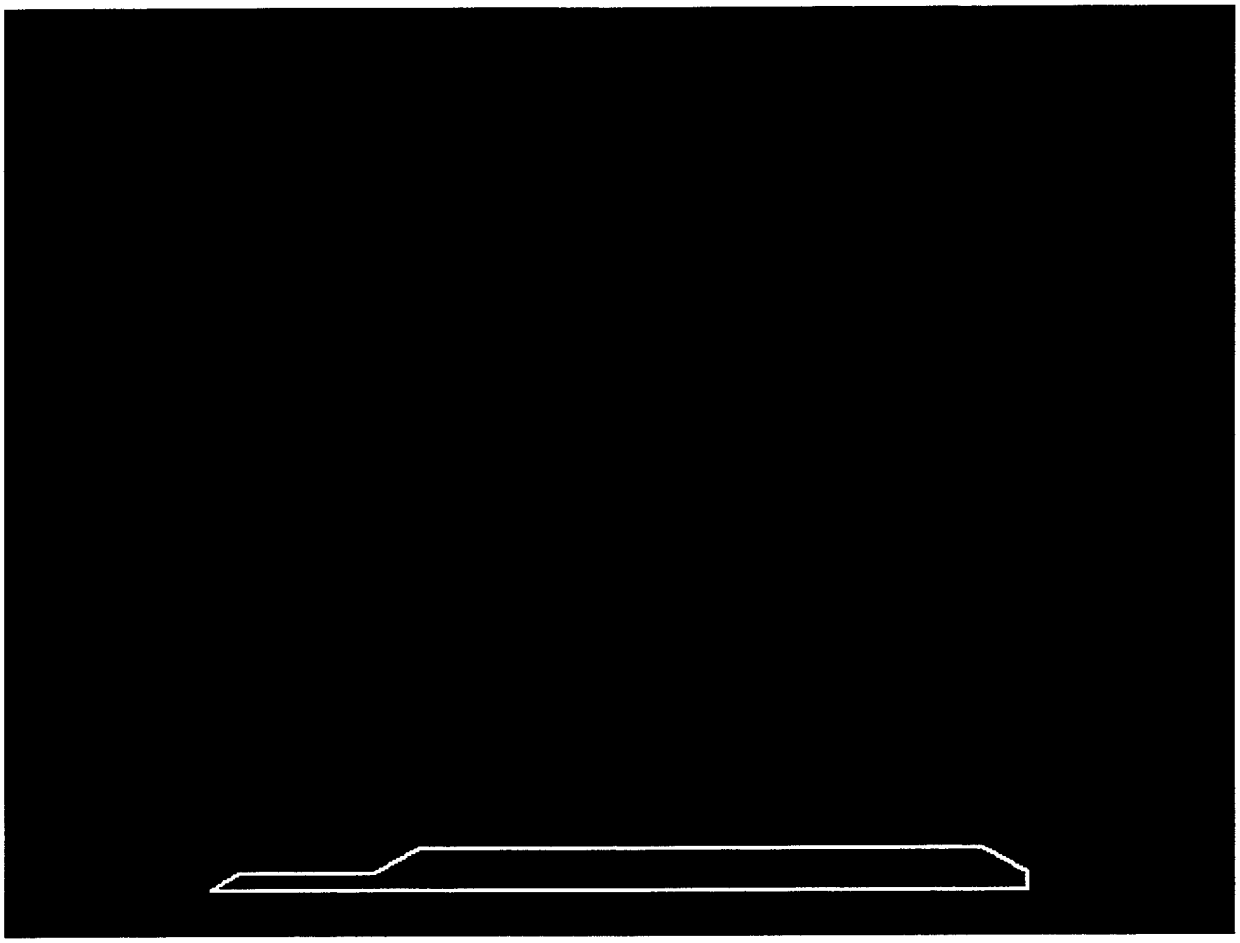


FIGURE 30. UNALTERED TAIL SKETCH EXAMPLE

Sketch Altered Tail pushbutton—The Sketch Altered Tail pushbutton is enabled when the Sketch Unaltered Tail pushbutton has been enabled and either the Maintain LE/TE Sweep Angles or the Maintain Taper Ratio pushbuttons has been selected. Upon choosing the Sketch Altered Tail pushbutton, a sketch of the altered lifting surface planform will be displayed on the screen. An example of a sketch is given in Figure 31. Hitting any key on the keyboard will remove the sketch and return the user to the Tail Geometry-Alter Planform data entry screen.

Apply To Double Wedge Airfoil radio button - The Apply To Double Wedge Airfoil radio button will be enabled when the Sketch Altered Tail pushbutton has been enabled and data has been entered into the Distance Of Tail Leading Edge From Nose Tip data field. Upon choosing the Apply To Double Wedge Airfoil Radio button, the Tail Geometry-Double-Wedge Airfoil data entry screen will be displayed. (See Section 3.2.2.7.1 for a discussion on the Tail Geometry-Double-Wedge Airfoil data entry screen.) The Leading Edge Sweep Angle, Semispan, Root Chord, and Tip Chord data entry fields will be auto-populated with the corresponding altered planform values.

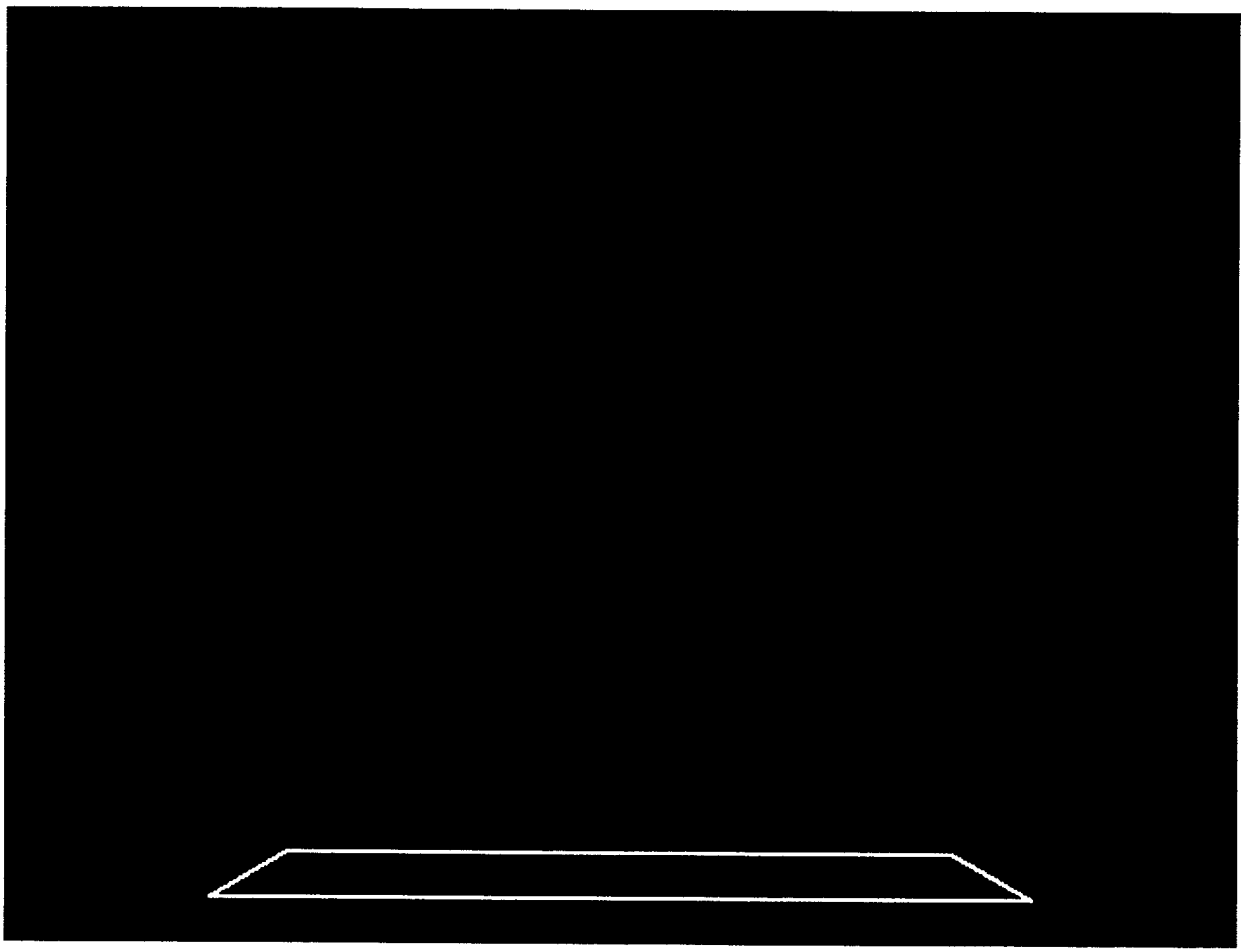


FIGURE 31. ALTERED TAIL SKETCH EXAMPLE

Apply To Biconvex Airfoil radio button—The Apply To Biconvex Airfoil radio button will be enabled when the Sketch Altered Tail pushbutton has been enabled and data has been entered into the Distance Of Tail Leading Edge From Nose Tip data field. Upon choosing the Apply To Biconvex Airfoil Radio button, the Tail Geometry-Biconvex Airfoil data entry screen will be displayed. (See Section 3.2.2.7.2 for a discussion on the Tail Geometry-Biconvex Airfoil data entry screen.) The Leading Edge Sweep Angle, Semispan, Root Chord, and Tip Chord data entry fields will be auto-populated with the corresponding altered planform values.

OK pushbutton—The OK pushbutton will be enabled when the Apply To Double Wedge Airfoil and Apply To Biconvex Airfoil radio buttons are enabled. By choosing the OK pushbutton you are confirming that data entry is complete and correct.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Tail Geometry-Alter Planform data entry screen without using the Alter Planform utility.

3.2.3 Free-Stream Conditions Data Entry Screens

3.2.3.1 Free-Stream Conditions-Alpha Sweep Data Entry Screen

The Free-Stream Conditions-Alpha Sweep data entry screen is depicted in Figure 32.

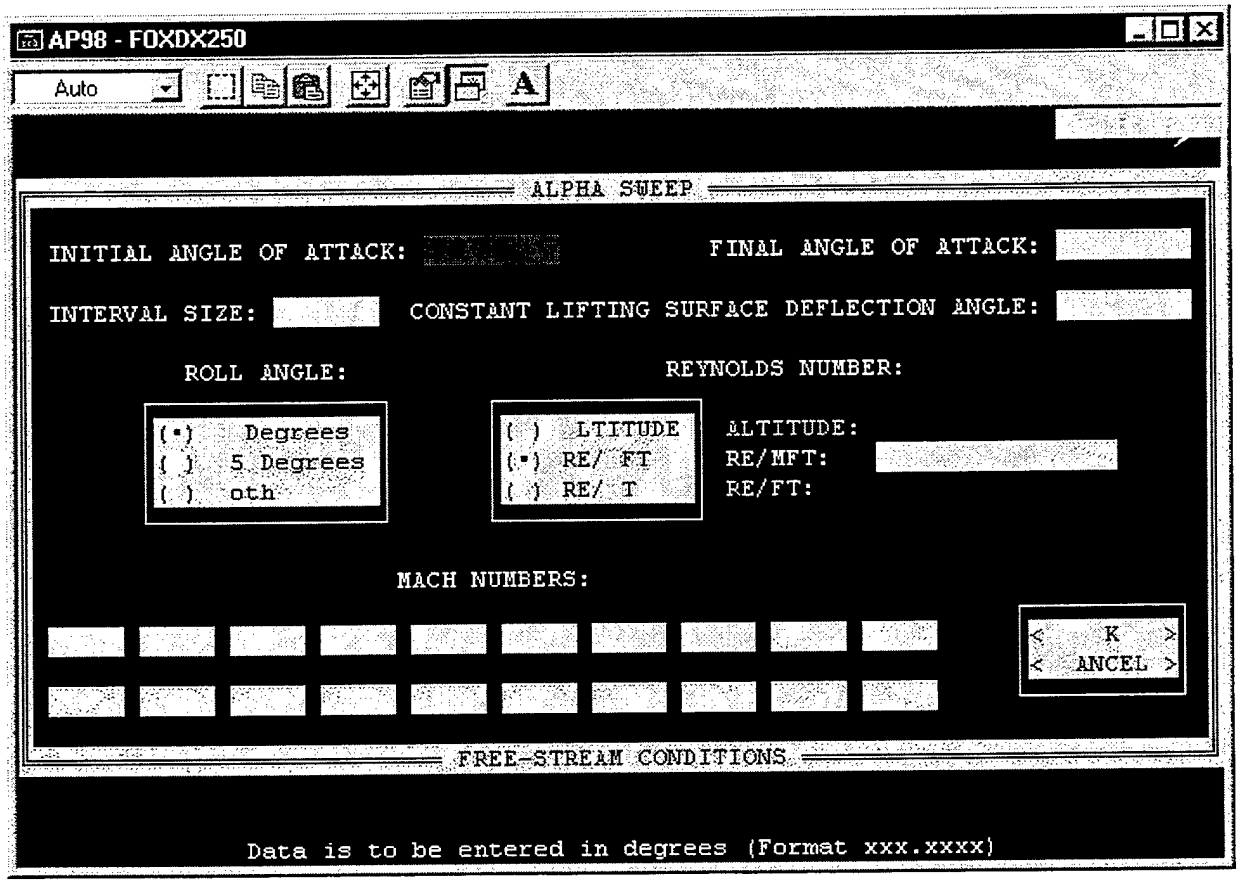


FIGURE 32. FREE-STREAM CONDITIONS-ALPHA SWEEP DATA ENTRY SCREEN

The Free-Stream Conditions-Alpha Sweep data entry screen consists of five data fields, a data field array, two sets of radio buttons, and two pushbuttons to be used as follows:

Initial Angle Of Attack data field—The entry of data into the Initial Angle Of Attack data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **AL**.*)

Final Angle Of Attack data field—The entry of data into the Final Angle Of Attack data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **AL**.*)

Interval Size data field—The entry of data into the Interval Size data field is mandatory. The number entered into this data field represents the incremental step size between each successive angle of attack in the sweep. If the interval size is not evenly divisible into the angle of attack range (Final Angle Of Attack - Initial Angle Of Attack), then the last angle of attack is set equal to the Final Angle Of Attack. The maximum number of angles of attack that are computed automatically by the AP98 Interface based upon the Interval Size is 20. (*This data corresponds to AP98 variable **AL**.*)

Constant Lifting Surface Deflection Angle data field—This data entry field is only activated when the chosen geometry type is a canard/wing-body-tail or a body-tail. The number entered into this data field represents a fin deflection angle relative to the missile body axis. The entry of data into the Constant Lifting Surface Deflection Angle data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **DELTAW** or **DELTAC**.*)

Roll Angle radio buttons—This data entry field is only activated when the chosen geometry type is a canard/wing-body-tail or a body-tail. Choosing the "0 Degrees" radio button will result in the generation of aerodynamics for a missile in the "plus" configuration. Choosing the "45 Degrees" radio button will result in the generation of aerodynamics for a missile in the "cross" configuration. Choosing the "Both" radio button will result in the generation of aerodynamics for a missile in both the "plus" and "cross" configurations. The "0 Degrees" radio button is selected as the default. *(This data corresponds to AP98 variable **IPHI**.)*

Reynolds Number radio buttons—This set of radio buttons is always enabled. The selection of an Altitude, RE/MFT, or RE/FT radio button will activate a corresponding data entry field. The RE/MFT radio button is selected as a default. The user must enter data into one of these data fields. A brief description of each radio button type is now given.

Altitude radio button—The user can specify a constant altitude at which the desired sweep will occur. The chosen altitude must be positive and no greater than 250000 feet. A Reynolds Number/Mach/Foot is computed automatically based upon standard atmospheric data at the designated altitude.

RE/MFT radio button—The user can directly specify a value of Reynolds Number/Mach/Foot which will be held constant over the desired sweep.

RE/FT radio button—The user can specify a value of Reynolds Number/Foot. Values of Reynolds Number/Mach/Foot are computed automatically based upon values of Mach numbers that are to be entered in the Mach Numbers data field array. (*This data corresponds to AP98 variable **RMF**.*)

Mach Numbers data field array—This data field array is always activated. The entry of at least one positive value into the Mach Number data field array is mandatory. A negative value for the Mach number should not be used. (*This data corresponds to AP98 variable **AM(MN)**.*)

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Free-Stream Conditions-Alpha Sweep data entry screen without processing the free-stream conditions-alpha sweep data.

3.2.3.2 Free-Stream Conditions-Delta Sweep Data Entry Screen

The Free-Stream Conditions-Delta Sweep data entry screen is depicted in Figure 33.

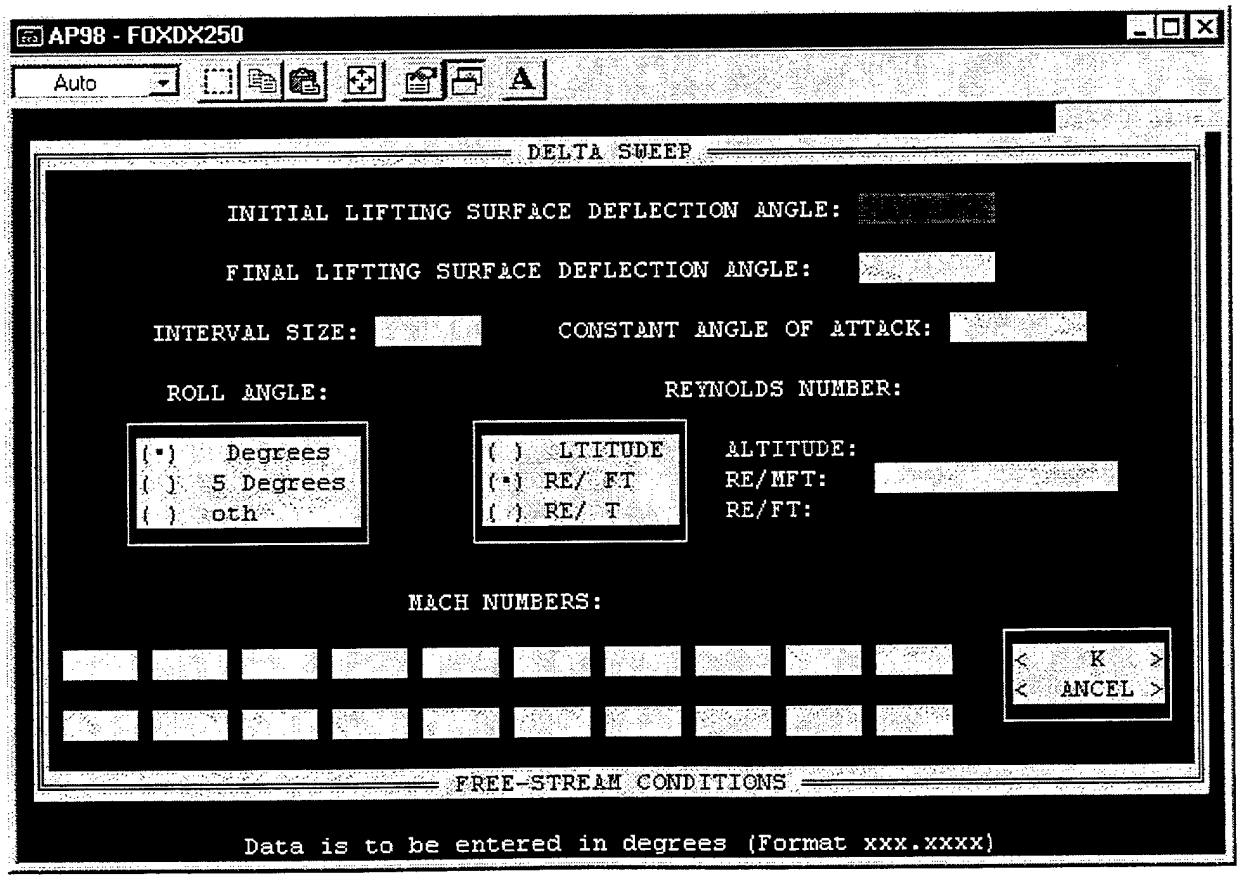


FIGURE 33. FREE-STREAM CONDITIONS-DELTA SWEEP DATA ENTRY SCREEN

The Free-Stream Conditions-Delta Sweep data entry screen consists of five data fields, two sets of radio buttons, a data field array, and two pushbuttons to be used as follows:

Initial Lifting Surface Deflection Angle data field—The entry of data into the Initial Lifting Surface Deflection Angle data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **DELTAW** or **DELTAC**.*)

Final Lifting Surface Deflection Angle data field—The entry of data into the Final Lifting Surface Deflection Angle data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **DELTAW** or **DELTAC**.*)

Interval Size data field—The entry of data into the Interval Size data field is mandatory. The number entered into this data field represents the incremental step size between each successive fin deflection angle in the sweep. If the interval size is not evenly divisible into the fin deflection range (Final Lifting Surface Deflection Angle - Initial Lifting Surface Deflection Angle), then the last fin deflection angle is set equal to the Final Lifting Surface Deflection Angle. The maximum number of fin deflection angles that are computed automatically by the AP98 Interface based upon the Interval Size is 20. (*This data corresponds to AP98 variable **DELTAW** or **DELTAC**.*)

Constant Angle Of Attack data field—The entry of data into the Constant Angle Of Attack data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **AL**.*)

Roll Angle radio buttons—See the discussion of the Roll Angle radio buttons in Section 3.2.3.1.

Reynolds Number radio buttons—See the discussion of the Reynolds Number radio buttons in Section 3.2.3.1.

Mach Numbers data field array—See the discussion of the Mach Numbers data field array in Section 3.2.3.1.

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Free-Stream Conditions-Delta Sweep data entry screen without processing the free-stream conditions-delta sweep data.

3.2.3.3 Free-Stream Conditions-Altitude Sweep Data Entry Screen

The Free-Stream Conditions-Altitude Sweep data entry screen is depicted in Figure 34.

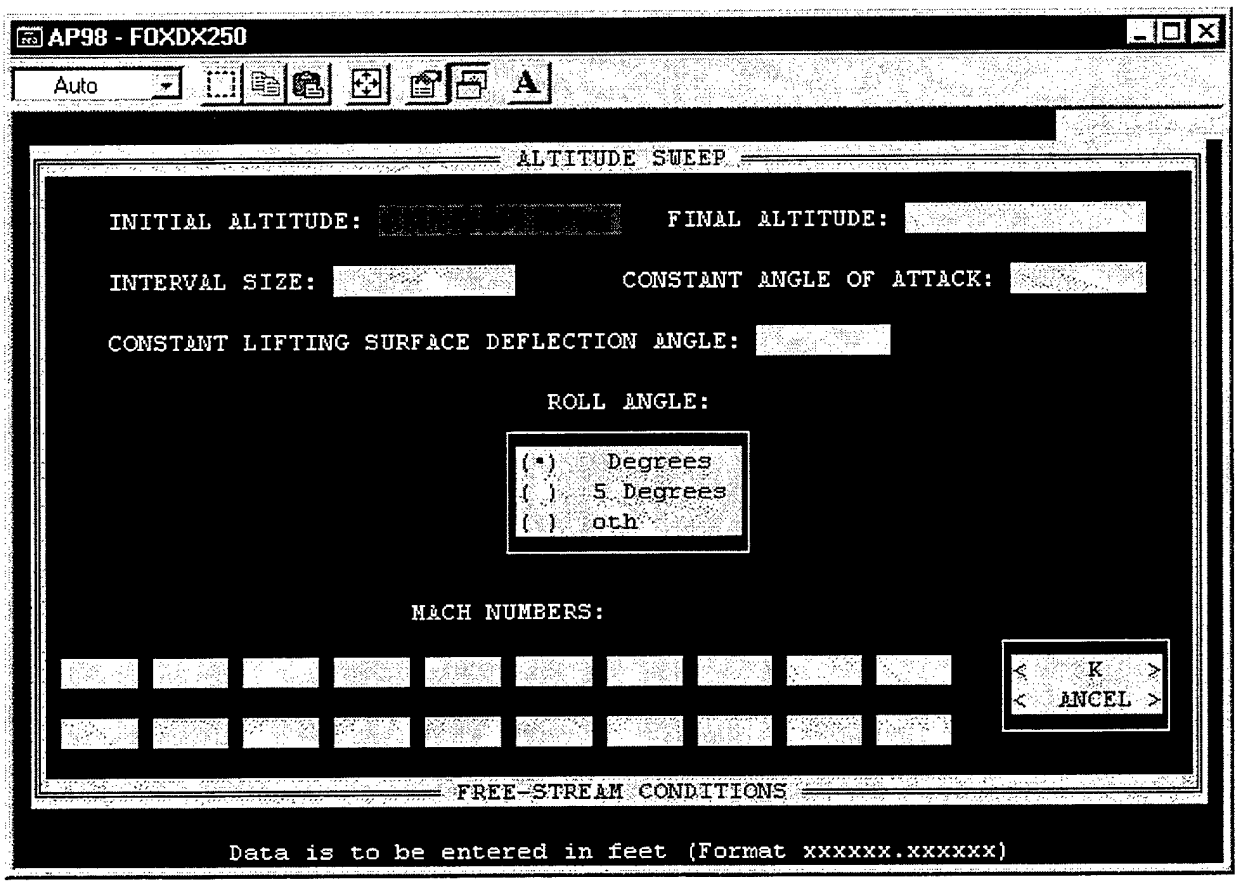


FIGURE 34. FREE-STREAM CONDITIONS-ALTITUDE SWEEP DATA ENTRY SCREEN

The Free-Stream Conditions-Altitude Sweep data entry screen consists of five data fields, a set of radio buttons, a Mach Number data field array, and two pushbuttons to be used as follows:

Initial Altitude data field—The entry of data into the Initial Altitude data field is not mandatory. A value of zero is entered as the default. The value used for the Initial Altitude should be less than the value used for the Final Altitude. (*This data is related to AP98 variable **RMF**.*)

Final Altitude data field—The entry of data into the Final Altitude data field is mandatory. The value used for the Final Altitude should be greater than the value used for the Initial Altitude. (*This data is related to AP98 variable **RMF**.*)

Interval Size data field—The entry of data into the Interval Size data field is mandatory. The number entered into this data field represents the incremental step size between each successive altitude in the sweep. If the interval size is not evenly divisible into the altitude range (Final Altitude - Initial Altitude), then the last altitude value is set equal to the Final Altitude. The maximum number of altitudes that are computed automatically by the AP98 Interface based upon the Interval Size is 20. A positive value for the Interval Size should be used. (*This data is related to AP98 variable **RMF**.*)

Constant Angle Of Attack data field—The entry of data into the Constant Angle Of Attack data field is not mandatory. A value of zero is entered as the default. (*This data is related to AP98 variable **AL**.*)

Constant Lifting Surface Deflection Angle data field—This data entry field is activated only when the chosen geometry type is a canard/wing-body-tail or a body-tail. The number entered into this data field represents a fin deflection angle relative to the missile body axis. The entry of data into the Constant Lifting Surface Deflection Angle data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **DELTAW** or **DELTAC**.*)

Roll Angle radio buttons—See the discussion of the Roll Angle radio buttons in Section 3.2.3.1.

Mach Numbers data fields—The entry of at least one positive value into the Mach Numbers data field is mandatory. A negative value for the Mach number should not be used. (*This data corresponds to AP98 variable **AM(MN)**.*)

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Free-Stream Conditions-Delta Sweep data entry screen without processing the free-stream conditions-altitude sweep data.

3.2.3.4 Free-Stream Conditions-Mach Sweep Data Entry Screen

The Free-Stream Conditions-Mach Sweep data entry screen is depicted in Figure 35.

The Free-Stream Conditions-Mach Sweep data entry screen consists of six data fields, two sets of radio buttons, and two pushbuttons to be used as follows:

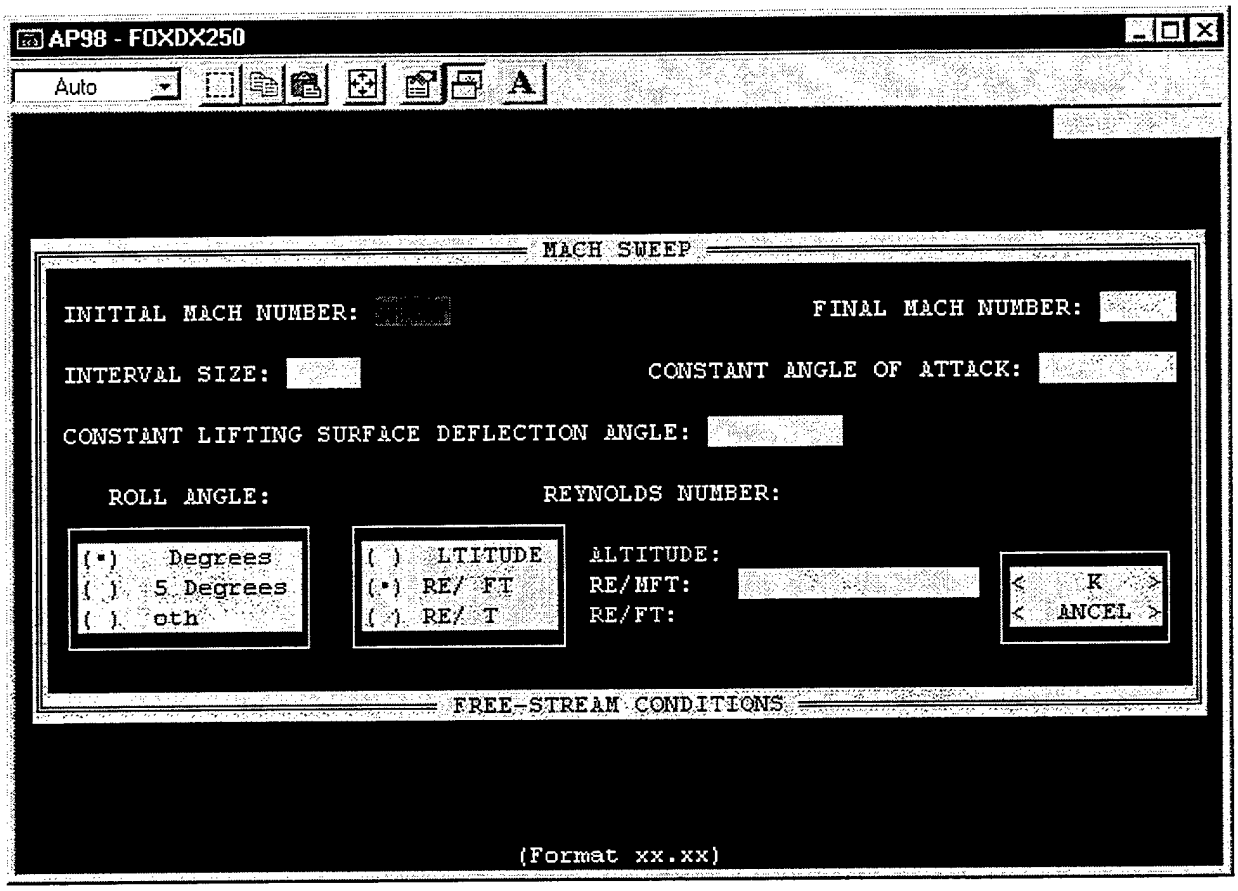


FIGURE 35. FREE-STREAM CONDITIONS-MACH SWEEP
DATA ENTRY SCREEN

Initial Mach Number data field—The entry of data into the Initial Mach Number data field is mandatory. The value entered into the data field should be positive and should be less than the value of the Final Mach Number. (*This data corresponds to AP98 variable **AM(MN)**.*)

Final Mach Number data field—The entry of data into the Final Mach Number data field is mandatory. The value entered into the data field should be positive and should be greater than the value of the Initial Mach Number. (*This data corresponds to AP98 variable **AM(MN)**.*)

Interval Size data field—The entry of data into the Interval Size data field is mandatory. The number entered into this data field represents the incremental step size between each successive Mach number in the sweep. If the interval size is not evenly divisible into the Mach range (Final Mach Number minus Initial Mach Number), then the last Mach number value is set equal to the Final Mach Number. The maximum number of Mach numbers that are computed automatically by the AP98 Interface based upon the Interval Size is 20. A positive value for the Interval Size should be used. (*This data corresponds to AP98 variable **AM(MN)**.*)

Constant Angle Of Attack data field—The entry of data into the Constant Angle Of Attack data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **AL**.*)

Constant Lifting Surface Deflection Angle data field—This data entry field is activated only when the chosen geometry type is a canard/wing-body-tail or a body-tail. The number entered into this data field represents a fin deflection angle relative to the missile body axis. The entry of data into the Constant Lifting Surface Deflection Angle data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **DELTAW** or **DELTAC**.*)

Roll Angle radio buttons—See the discussion of the Roll Angle radio buttons in Section 3.2.3.1.

Reynolds Number radio buttons—See the discussion of the Reynolds Number radio buttons in Section 3.2.3.1.

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Free-Stream Conditions-Mach Sweep data entry screen without processing the free-stream conditions-Mach sweep data.

3.2.3.5 Free-Stream Conditions-Other Data Entry Screen

The Free-Stream Conditions-Other data entry screen is depicted in Figure 36. It is useful to choose this free-stream condition type when the desired run matrix is non-uniform or does not lend itself to a particular type of sweep.

The Free-Stream Conditions-Other data entry screen consists of one data field, a set of radio buttons, and two pushbuttons to be used as follows:

Number Of Cases data field—The entry of data into the Number Of Cases data field is mandatory. The maximum number of cases is 20. (*This data corresponds to AP98 variable **M**.*)

Specify Constant Parameters radio buttons—The Specify Constant Parameters radio buttons are enabled when the user completes data input to the Number Of Cases data field. The choice of a Specify Constant Parameters radio button is not mandatory. The "No" radio button is selected as the default. By selecting the "Yes" radio button, the user will be able to specify the values of any parameters that are constant throughout the run

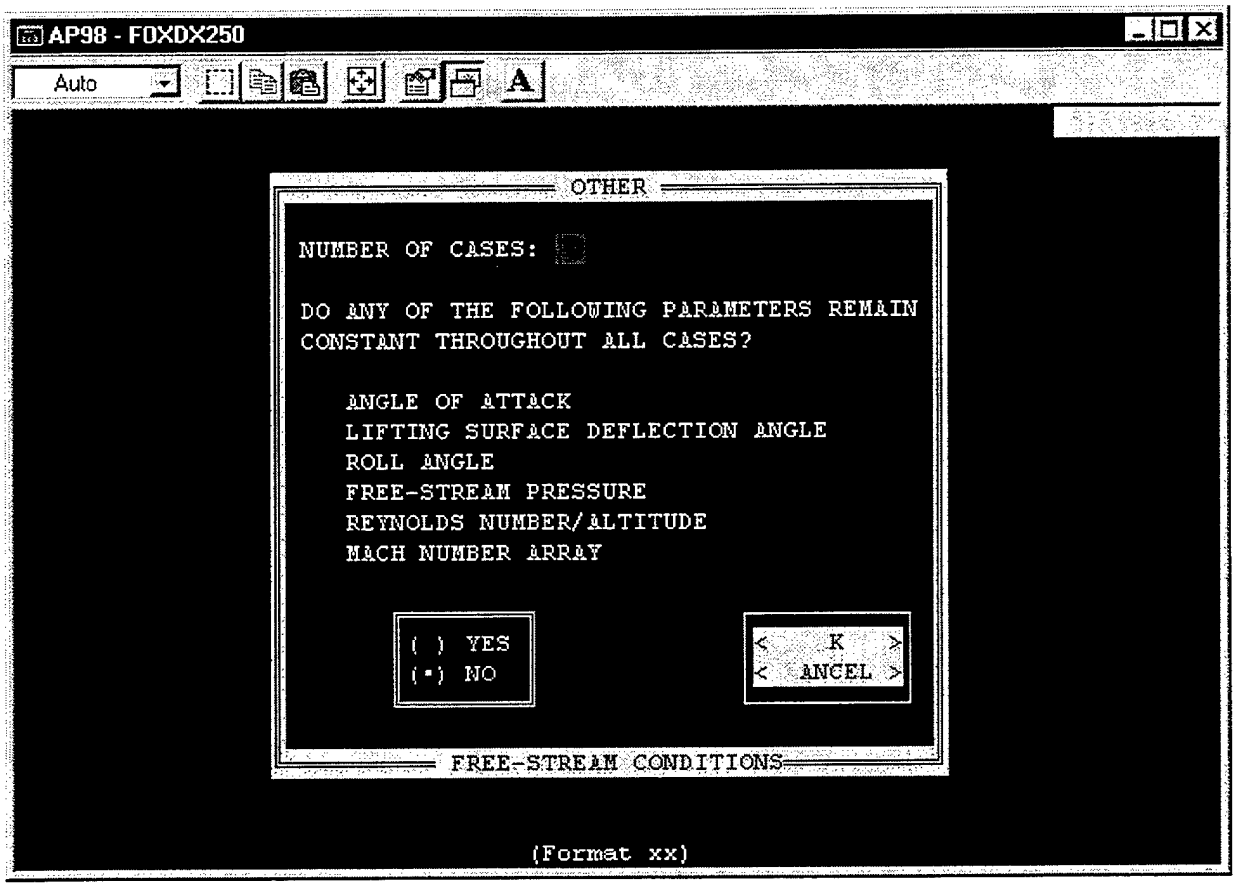


FIGURE 36. FREE-STREAM CONDITIONS-OTHER DATA ENTRY SCREEN

matrix. This allows the user to avoid the repetitive entry of data parameters that are constant.

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Free-Stream Conditions-Other data entry screen without processing the free-stream conditions-other data.

3.2.3.5.1 Free-Stream Conditions-Other (For Constants) Data Entry Screen.

The Free-Stream Conditions-Other (for constants) data entry screen is depicted in Figure 37. In order to gain access to this data entry screen, the user must select the "Yes" Specify Constant Parameters radio button. See Section 3.2.3.5 for a discussion on the Specify Constant Parameters radio buttons.

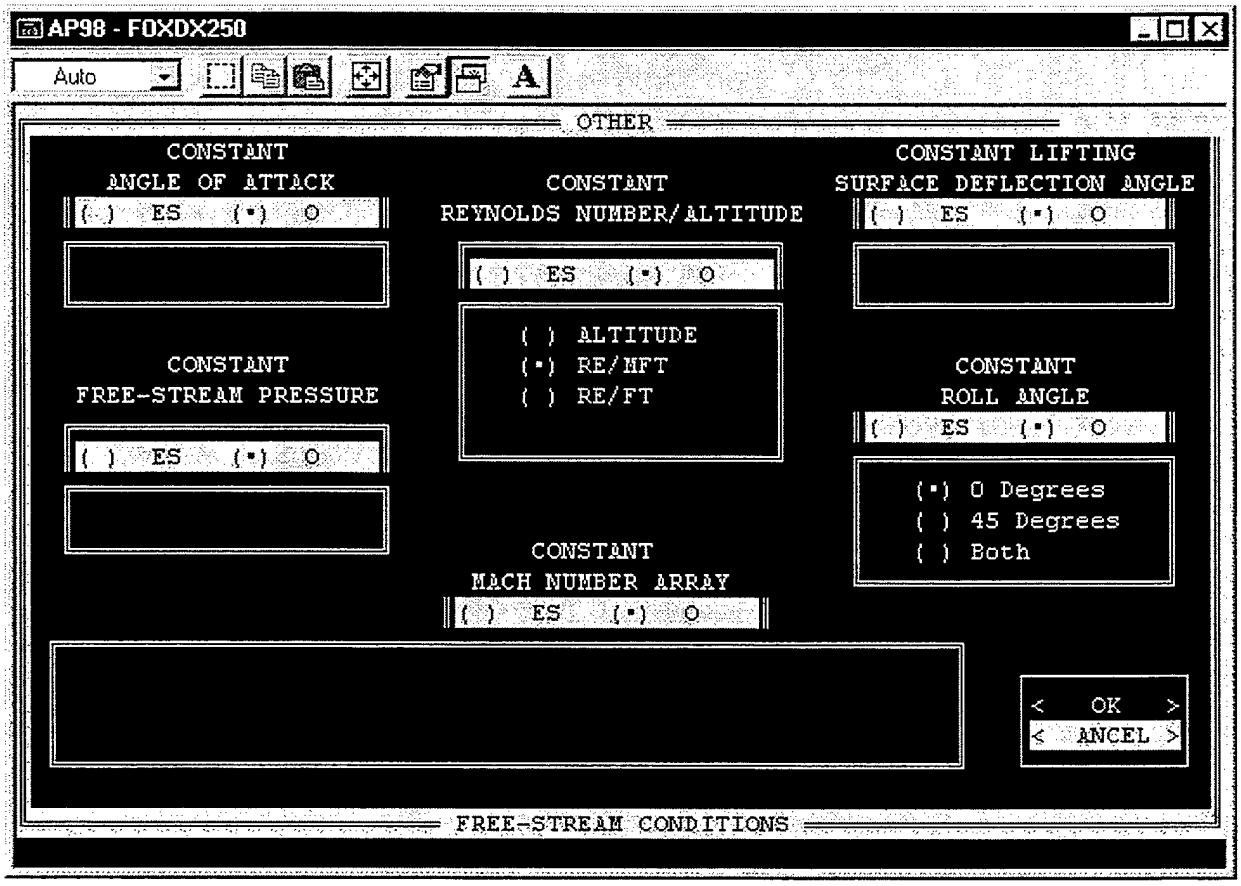


FIGURE 37. FREE-STREAM CONDITIONS-OTHER (FOR CONSTANTS) DATA ENTRY SCREEN

The Free-Stream Conditions-Other (for constants) data entry screen consists of six sets of radio buttons, and two pushbuttons to be used as follows:

Constant Angle Of Attack radio buttons—The choice of a Constant Angle Of Attack radio button is not mandatory. The "No" radio button is selected as the default. Selecting the "Yes" radio button will enable a data field into which the user can enter a Constant Angle Of Attack value. (*This data corresponds to AP98 variable **AL**.*)

Constant Lifting Surface Deflection Angle radio buttons—The Constant Lifting Surface Deflection Angle radio buttons are enabled only for canard/wing-body-tail and body-tail geometry types. The choice of a Constant Lifting Surface Deflection Angle radio button is not mandatory. The "No" radio button is selected as the default. Selecting the "Yes" radio button will enable a data field into which the user can enter a Constant Lifting Surface Deflection Angle value. (*This data corresponds to AP98 variable **DELTAW** or **DELTAC**.*)

Constant Free-Stream Pressure radio buttons—The choice of a Constant Free-Stream Pressure radio button is not mandatory. The "No" radio button is selected as the default. Selecting the "Yes" radio button will enable a data field into which the user can enter a Constant Free-Stream Pressure value. (*This data corresponds to AP98 variable **PIN**.*)

Constant Reynolds Number/Altitude radio buttons—The choice of a Constant Reynolds Number/Altitude radio button is not mandatory. The "No" radio button is selected as the default. Selecting the "Yes" radio button will enable a second tier set of radio buttons and a data entry field. There are three radio buttons in this second tier:

1) Altitude radio button—By selecting this second tier radio button, the user can specify a constant altitude to be used for all cases in the run matrix. The specified altitude must be positive and no greater than 250000 feet. A Reynolds Number/Mach/Foot is computed automatically based upon standard atmospheric data at the designated altitude.

2) RE/MFT radio button—By selecting this second tier radio button, the user can directly specify a value of Reynolds Number/Mach/Foot which will be held constant for all cases in the run matrix.

3) RE/FT radio button—By selecting this second tier radio button, the user can specify a constant Reynolds Number/Foot to be used for all cases in the run matrix. Values of Reynolds Number/Mach/Foot are computed automatically based upon values of Mach numbers that are entered in the Mach number data field array.

Selection of a second tier radio button is not mandatory, and the RE/MFT radio button is selected as a default. (*This data corresponds to AP98 variable **RMF**.*)

Constant Roll Angle radio buttons—The choice of a Constant Roll Angle radio button is not mandatory. The "0 Degrees" radio button is selected as the default. Choosing the "0 Degrees" radio button will result in the generation of aerodynamics for a missile in the "plus" configuration. Choosing the "45 Degrees" radio button will result in the generation of aerodynamics for a missile in the "cross" configuration. Choosing the "Both" radio button will result in the generation of aerodynamics for a missile in both the "plus" and "cross" configurations. (*This data corresponds to AP98 variable **IPHI**.*)

Constant Mach Number Array radio buttons—The choice of a Constant Mach Number Array radio button is not mandatory. The "No" radio button is selected as the default. Selecting the "Yes" radio button will enable an array of data fields into which the user can enter a set of values to be used as a Constant Mach Number Array. The user must enter at least one value into the Constant Mach Number Array. A negative Mach number value should not be used. (*This data corresponds to AP98 variable **AM(MN)**.*)

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. If no data has been entered into the Free-Stream Conditions-Other (for constants) data screen, then no free-stream parameters will be held constant automatically.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Free-Stream Conditions-Other (for constants) data entry screen without processing the free-stream conditions-Other (for constants) data.

3.2.3.5.2 Free-Stream Conditions-Other (For Variables) Data Entry Screen

The Free-Stream Conditions-Other (for variables) Data Entry Screen is depicted in Figure 38. The user must select the "OK" pushbutton on the Free-Stream Conditions-Other data entry screen as a prerequisite to gaining access to the Free-Stream Conditions-Other (for variables) data screen. See Section 3.2.3.5 for a discussion on the Free-Stream Conditions-Other data entry screen. When the user completes the entry of data into the Free-Stream Conditions-Other (for variables) data entry screen, another empty data screen will be displayed until the free-stream data for each case has been input.

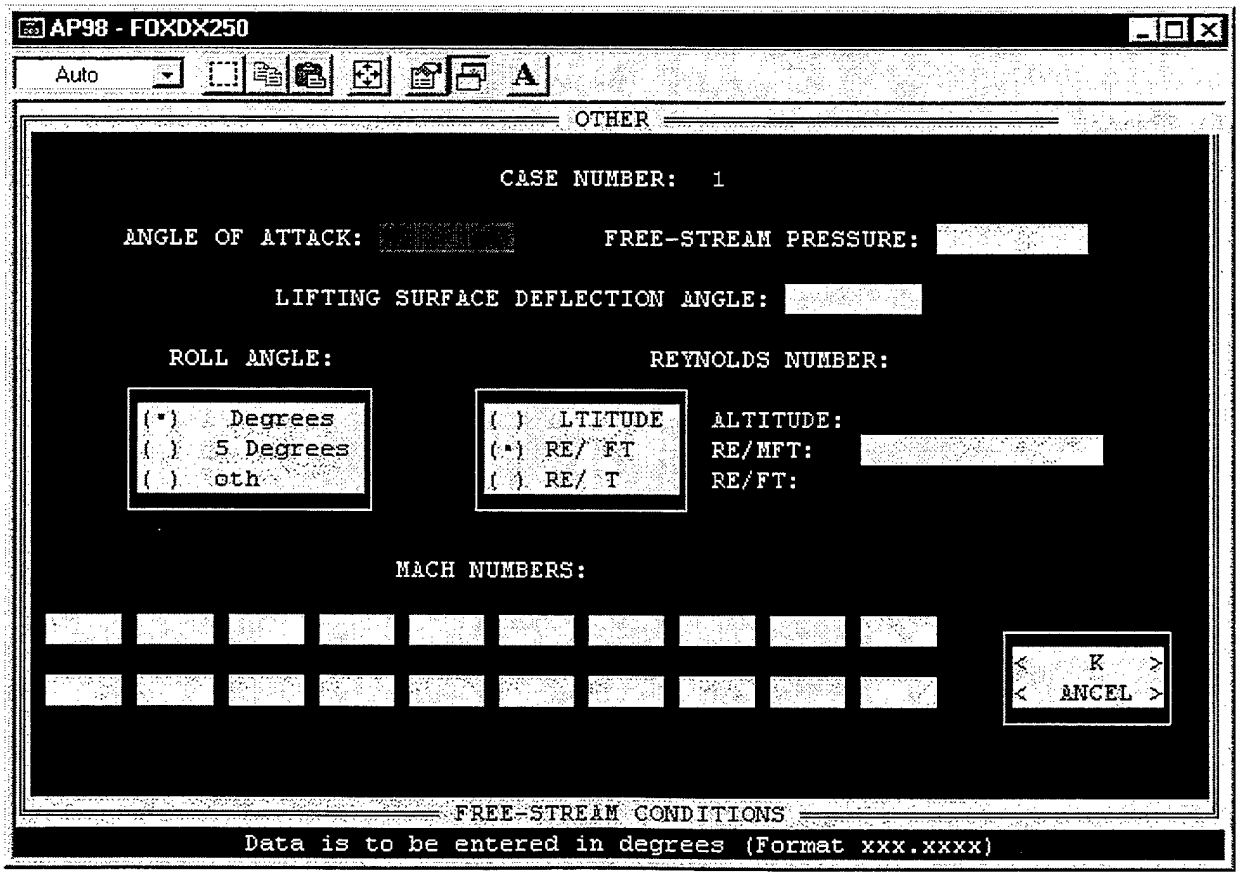


FIGURE 38. FREE-STREAM CONDITIONS-OTHER (FOR VARIABLES) DATA ENTRY SCREEN

The Free-Stream Conditions-Other (for variables) data entry screen consists of three data fields, two sets of radio buttons, a Mach number data field array, and two pushbuttons to be used as follows:

Angle Of Attack data field—This data field is always enabled unless the user has specified a Constant Angle Of Attack in the Free-Stream Conditions-Other (for constants) data entry screen (see Section 3.2.3.5.1). The entry of data into the Angle Of Attack data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **AL**.*)

Free-Stream Pressure data field—This data field is always enabled unless the user has specified a Constant Free-Stream Pressure in the Free-Stream Conditions-Other (for constants) data entry screen (see Section 3.2.3.5.1). The entry of data into the Free-Stream Pressure data field is not mandatory. A default value will be computed based upon altitude data. (*This data corresponds to AP98 variable **PIN**.*)

Lifting Surface Deflection Angle data field—This data field will be enabled only for canard/wing-body-tail and body-tail geometry types as long as the user has not specified a Constant Lifting Surface Deflection Angle in the Free-Stream Conditions-Other (for constants) data entry screen (see Section 3.2.3.5.1). The entry of data into the Lifting Surface Deflection Angle data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **DELTAW** or **DELTAC**.*)

Roll Angle radio buttons—This set of radio buttons will be enabled only for canard/wing-body-tail and body-tail geometry types as long as the user has not specified a Constant Roll Angle radio button in the Free-Stream Conditions-Other (for constants) data entry screen (see Section 3.2.3.5.1). The choice of a Roll Angle radio button is not mandatory. The "0 Degrees" radio button is selected as the default. Choosing the "0 Degrees" radio button will result in the generation of aerodynamics for a missile in the "plus" configuration. Choosing the "45 Degrees" radio button will result in the generation of aerodynamics for a missile in the "cross" configuration. Choosing the "Both" radio button will result in the generation of aerodynamics for a missile in both the "plus" and "cross" configurations. (*This data corresponds to AP98 variable **IPHI**.*)

Reynolds Number radio buttons—This set of radio buttons is always enabled unless the user has specified a Constant Reynolds Number/Altitude in the Free-Stream Conditions-Other (for constants) data entry screen (see Section 3.2.3.5.1). The choice of a Reynolds Number radio button is not mandatory. The RE/MFT Reynolds Number radio button is selected as the default. The selection of either the Altitude radio button or RE/MFT radio button will activate a corresponding data entry field. The user must enter data into one of these fields. A brief description of each radio button type is now given.

Altitude radio button—By selecting this radio button, the user can specify a desired altitude, which is to be used for the current case in the run matrix. The specified altitude must be positive and no greater than 250000 feet. A Reynolds Number/Mach/Foot is computed automatically based upon standard atmospheric data at the designated altitude.

RE/MFT radio button—By selecting this radio button, the user can directly specify a value of Reynolds Number/Mach/Foot, which is to be used for the current case in the run matrix.

RE/FT radio button—By selecting this radio button, the user can specify a Reynolds Number/Foot to be used for the current case in the run matrix. Values of Reynolds Number/Mach/Foot are computed automatically based upon values of Mach numbers that are entered in the Mach number data field array. (*This data corresponds to AP98 variable **RMF**.*)

Mach Numbers data fields—The Mach Numbers data fields will always be enabled unless the user has specified a Constant Mach Number Array in the Free-Stream Conditions-Other (for constants) data entry screen (see Section 3.2.3.5.1). The entry of at least one positive value into the Mach Numbers data field is mandatory. A negative value for the Mach number should not be used. (*This data corresponds to AP98 variable **AM(MN)**.*)

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Free-Stream Conditions-Other (for variables) data entry screen without processing the free-stream conditions-other (for variables) data.

3.2.4 Options Data Entry Screens

3.2.4.1 Aeroprediction-Options Data Entry Screen

The Aeroprediction-Options data entry screen is depicted in Figure 39.

The Aeroprediction-Options data entry screen consists of six sets of radio buttons, six data fields, and two pushbuttons to be used as follows:

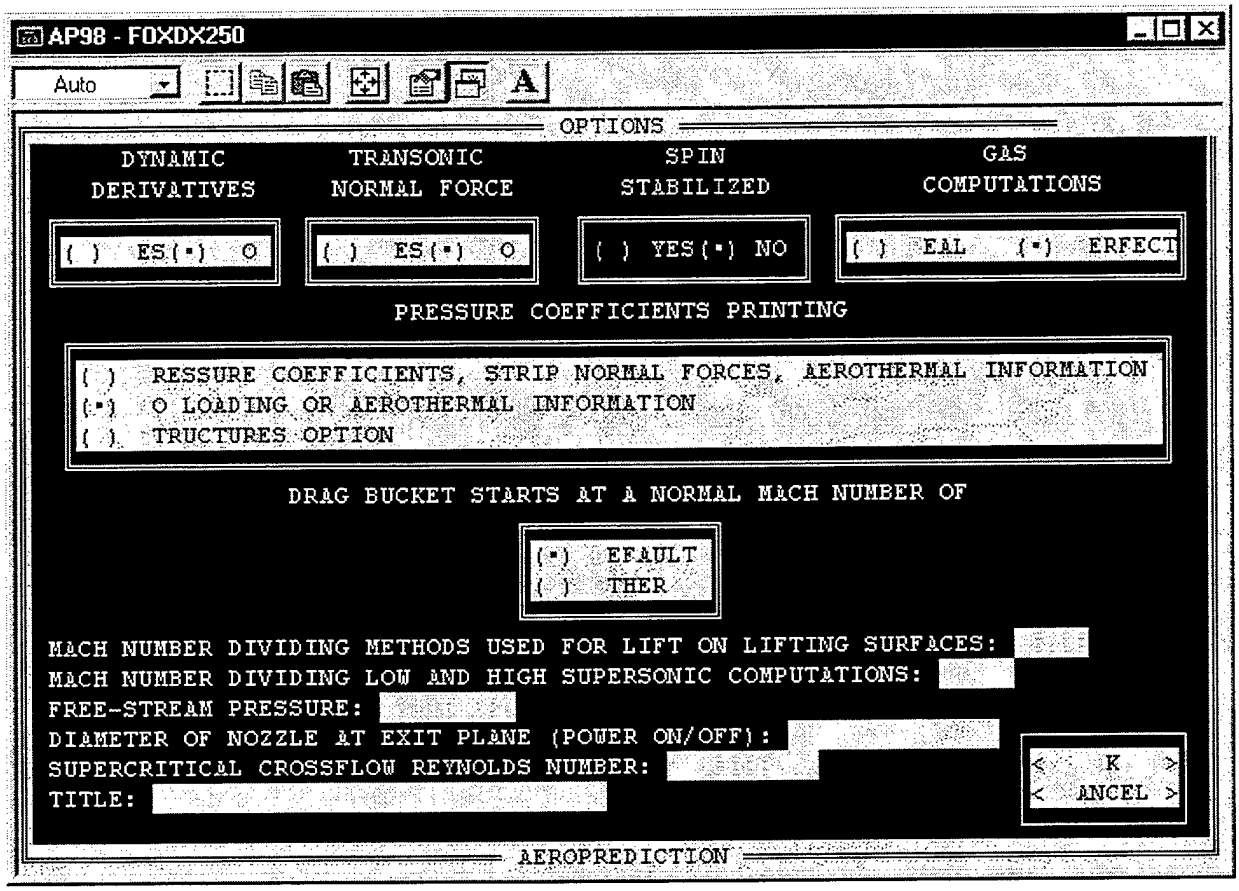


FIGURE 39. AEROPREDICTION-OPTIONS DATA ENTRY SCREEN

Dynamic Derivatives radio buttons—The choice of a Dynamic Derivatives radio button is not mandatory. The "No" radio button is selected as the default. Selecting the "Yes" radio button will result in the computation of dynamic derivatives. (*This data corresponds to AP98 variable **NDYM**.*)

Transonic Normal Force radio buttons—The choice of a Transonic Normal Force radio button is not mandatory. The "No" radio button is selected as the default. Selecting the "Yes" radio button will result in the computation of NEAR transonic normal force. (*This data corresponds to AP98 variable **NSWTCH**.*)

Spin Stabilized radio buttons—The Spin Stabilized radio button is enabled only for body alone geometry types. The choice of a Spin Stabilized radio button is not mandatory. The "No" radio button is selected as the default. Selecting the "Yes" radio button indicates that the body alone geometry is spin stabilized. (*This data corresponds to AP98 variable **ISPIN**.*)

Gas Computations radio buttons—The Gas Computations radio buttons will be enabled unless an altitude sweep has been chosen for the free-stream conditions. The choice of a Gas Computations radio button is not mandatory. The "Perfect" radio button is selected

as the default. If this radio button is chosen, then computations will be performed with perfect gas assumptions. Selecting the "Real" radio button will result in the display of the Aeroprediction-Real-Gas Option Data data entry screen. See Section 3.2.4.1.1 for a discussion on the use of the Aeroprediction-Real-Gas Option Data data entry screen. (*This data corresponds to AP98 variable **IGAS**.*)

Pressure Coefficients Printing radio buttons—The choice of a Pressure Coefficients Printing radio button is not mandatory. The "No Loading Or Aerothermal Information" radio button is selected as the default. A brief description of each radio button is as follows:

Pressure Coefficients, Strip Normal Forces, Aerothermal Information radio button—Selecting this radio button will result in the printing of pressure coefficients, strip normal forces, and aerothermal information to the output file.

No Loading Or Aerothermal Information radio button—If this radio button is selected, then no loading or aerothermal information is printed out in the output file.

Structures Option radio button—Selection of this radio button will activate the structures option. If the user has chosen an altitude sweep in the free-stream conditions, this radio button will not be enabled. (*This data corresponds to AP98 variable **IPRINT**.*)

Drag Bucket Starts At A Normal Mach Number Of radio buttons—The choice of a Drag Bucket Starts At A Normal Mach Number Of radio button is not mandatory. The "Default" radio button is selected as the default. When the "Default" radio button is selected, the drag bucket will start at a normal Mach number of 0.0 for Mach numbers less than 0.6 and will start at a normal Mach number of 0.1 for Mach numbers greater than 0.9. A linear interpolation is used for Mach numbers between 0.6 and 0.9. The selection of the "Other" radio button will activate a data field into which the user must enter a positive valued, normal Mach number where the drag bucket should start. (*This data corresponds to AP98 variable **AMCADJ**.*)

Mach Number Dividing Methods Used For Lift On Lifting Surfaces data field—The entry of data into this data field is not mandatory. A default value is computed automatically by adding 1.0 to the highest Mach number entered in the free-stream conditions. If the user changes the free-stream Mach numbers at any time, a new default value will be computed automatically. Therefore, if the user desires a value other than the default value, the desired value should be entered after the latest entry of freestream Mach number data. (*This data corresponds to AP98 variable **ALIMS**.*)

Mach Number Dividing Low And High Supersonic Computations data field—The entry of data into this field is not mandatory. A default value is computed automatically by subtracting 0.1 from the lowest Mach number entered in the free-stream conditions. If a value of zero is entered, then AP98 will compute a value automatically based upon the logic described in Section 4.3. (*This data corresponds to AP98 variable **ALIMIT**.*)

Free-Stream Pressure data field—The entry of data into this field is not mandatory. A default value for the free-stream pressure is found based upon altitude by using standard atmospheric data tables. If no altitude data was entered in the free-stream conditions, then standard sea level pressure is assumed. (*This data corresponds to AP98 variable **PINF**.*)

Diameter Of Nozzle At Exit Plane (Power On/Off) data field—This data field is not enabled for wing-alone geometry types. Entry of data into this data field is not mandatory. A value of 0.01 is used as a default. Selecting a value greater than 0.1 will result in the display of the Aeroprediction-Power-On Option Data data entry screen. See Section 3.2.4.1.2 for a discussion on the Aeroprediction-Power-On Option Data data screen. (*This data corresponds to AP98 variable **DJ**.*)

Supercritical Crossflow Reynolds Number—The entry of data into this field is not mandatory. A default value of 180000.0 is used. (*This data corresponds to AP98 variable **REYCRT**.*)

Title data field—The entry of a title into this data field is mandatory. (*This data corresponds to AP98 CARD TYPE III.*)

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Aeroprediction-Options Data data entry screen without processing the data from the Aeroprediction-Options Data.

3.2.4.1.1 Aeroprediction-Real-Gas Option Data, Data Entry Screen

The Aeroprediction-Real-Gas Option Data data entry screen is depicted in Figure 40. In order to gain access to this data screen, the user must choose the "Real" radio button in the Gas Computations radio box in the Aeroprediction-Options data screen. See Section 3.2.4.1 for a discussion on the Gas Computations radio buttons.

The Aeroprediction-Real-Gas Option Data data entry screen consists of a set of radio buttons, seven data fields, and two pushbuttons to be used as follows:

Nose Shape radio buttons—The choice of a Nose Shape radio button is not mandatory. The "Other Body Shapes" radio button is selected as the default. (*This data corresponds to AP98 variable **INOSE**.*)

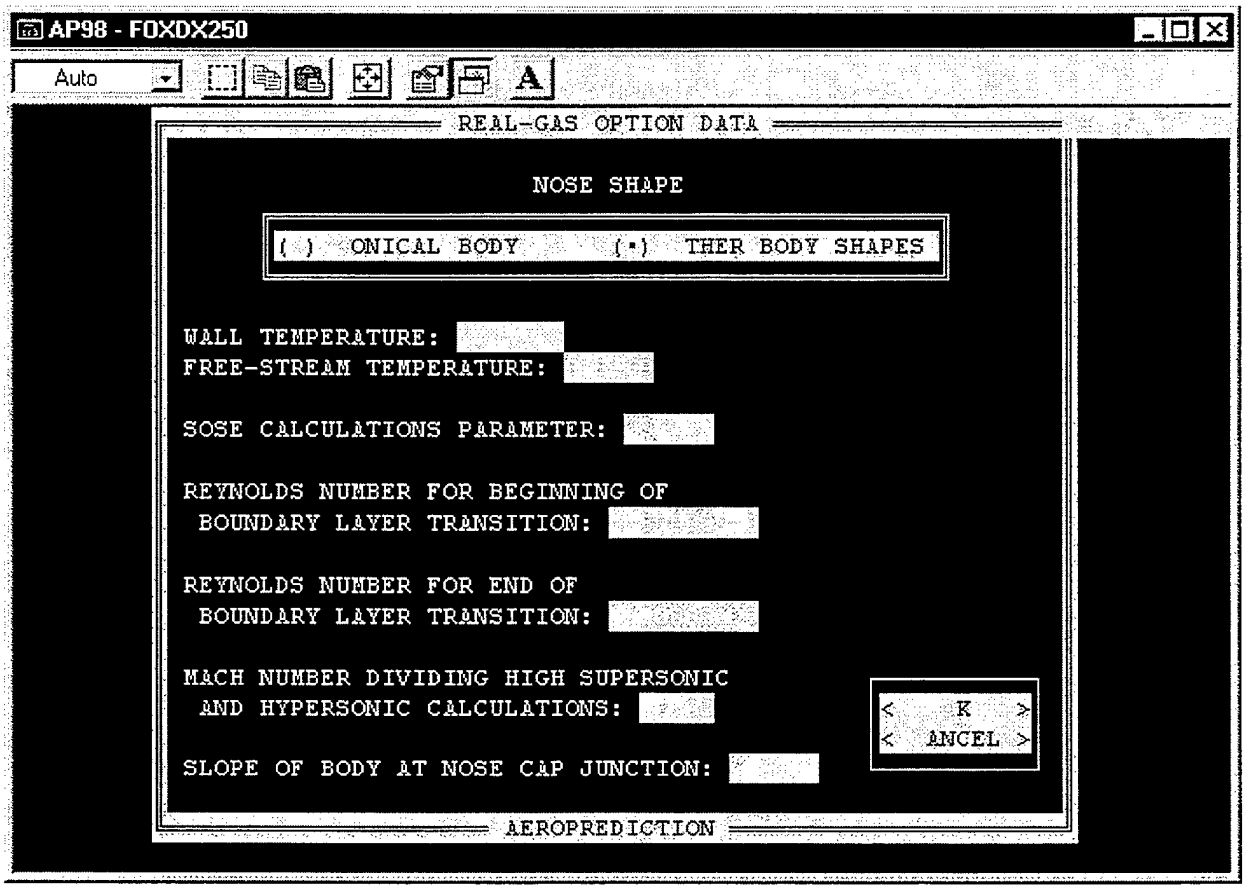


FIGURE 40. AEROPREDICTION-REAL-GAS OPTION DATA, DATA ENTRY SCREEN

Wall Temperature data field—The entry of data into the Wall Temperature data field is mandatory. (*This data corresponds to AP98 variable **TW**.*)

Free-Stream Temperature data field—The entry of data into the Free-Stream Temperature data field is not mandatory. A default value for the free-stream temperature is found based upon altitude by using standard atmospheric data tables. If no altitude data was entered in the free-stream conditions, then standard sea level temperature is assumed. (*This data corresponds to AP98 variable **TINF**.*)

SOSE Calculations Parameter data field—The entry of data into the SOSE Calculations Parameter data field is not mandatory. A value of zero is entered as the default. (*This data corresponds to AP98 variable **ETAP**.*)

Reynolds Number For Beginning Of Boundary Layer Transition data field—The entry of data into the Reynolds Number For Beginning Of Boundary Layer Transition data field is not mandatory. A value of 500000 is entered as the default. (*This data corresponds to AP98 variable **RNLWR**.*)

Reynolds Number For End Of Boundary Layer Transition data field—The entry of data into the Reynolds Number For End Of Boundary Layer Transition data field is not mandatory. A value of 1000000 is entered as the default. (*This data corresponds to AP98 variable **RNUPR**.*)

Mach Number Dividing High Supersonic And Hypersonic Calculations data field—The entry of data into the Mach Number Dividing High Supersonic And Hypersonic Calculations data field is not mandatory. A value of 6.0 is entered as the default. (*This data corresponds to AP98 variable **AMHIGH**.*)

Slope Of Body At Nose Cap Junction data field—The entry of data into the Slope Of Body At Nose Cap Junction data field is not mandatory. A value of 10 degrees is entered as the default. Note: The value entered in this data field should be at least 6 degrees. (*This data corresponds to AP98 variable **CONANG**.*)

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Aeroprediction-Real-Gas Option Data data entry screen without processing the Aeroprediction-Real-Gas Options Data data.

3.2.4.1.2 Aeroprediction-Power-On Option Data, Data Entry Screen

The Aeroprediction-Power-On Option Data data entry screen is depicted in Figure 41. In order to gain access to this data screen, the user must enter a value of greater than 0.1 in the Diameter Of Nozzle At Exit Plane (Power On/Off) data field in the Aeroprediction-Options data screen.

See Section 3.2.4.1 for a discussion on the Diameter Of Nozzle At Exit Plane (Power On/Off) data field.

The Aeroprediction-Power-On Option Data data entry screen consists of four data fields and two pushbuttons to be used as follows:

Area Of Nozzle Exit Divided By Nozzle Throat Area data field—The entry of data into the Area Of Nozzle Exit Divided By Nozzle Throat Area data field is mandatory. (*This data corresponds to AP98 variable **AJ**.*)

Distance Of Nozzle Exit Plane From Body Base data field—The entry of data into the Distance Of Nozzle Exit Plane From Body Base data field is mandatory. (*This data corresponds to AP98 variable **XJ**.*)

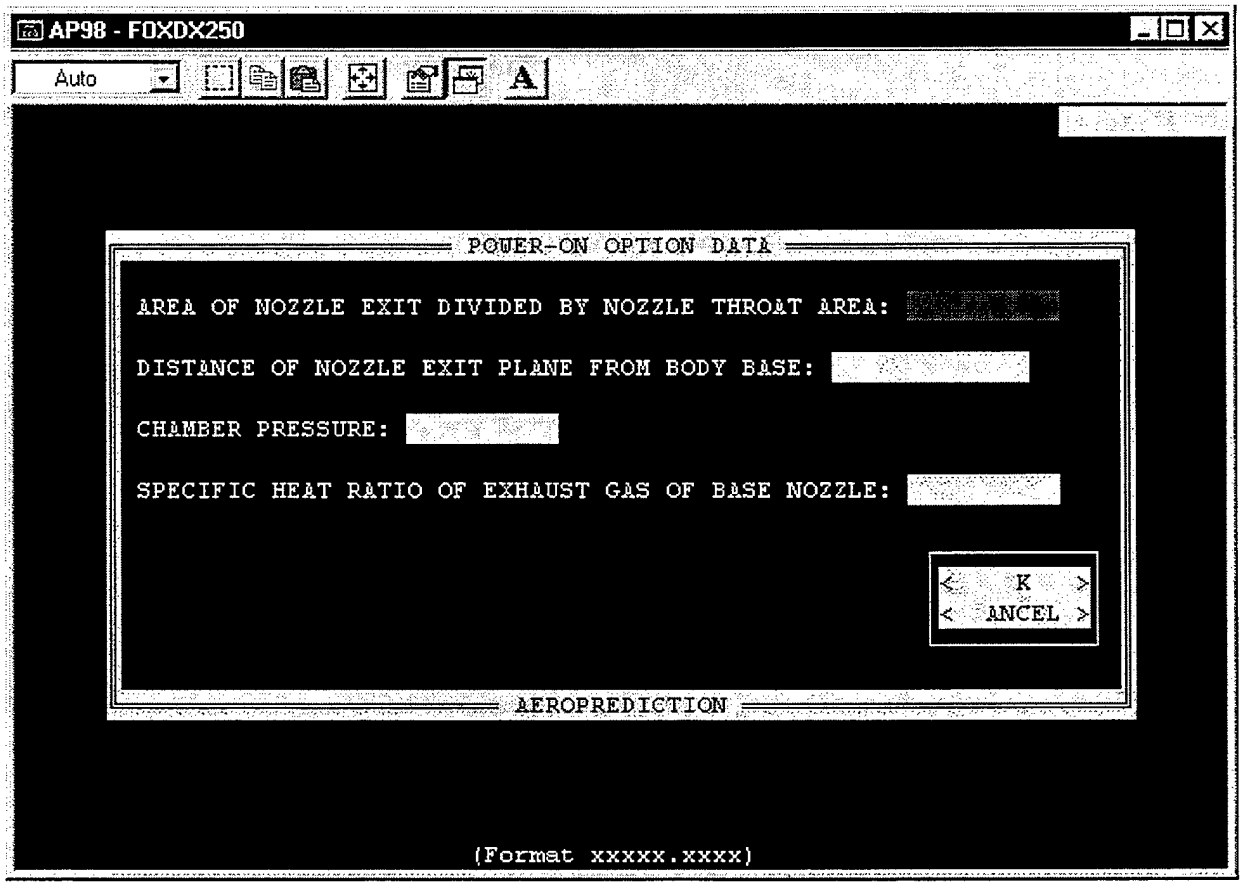


FIGURE 41. AEROPREDICTION-POWER-ON OPTION DATA, DATA ENTRY SCREEN

Chamber Pressure data field—The entry of data into the Chamber Pressure data field is mandatory. (*This data corresponds to AP98 variable **PC*PINF**.*)

Specific Heat Ratio Of Exhaust Gas Of Base Nozzle data field—The entry of data into the Specific Heat Ratio Of Exhaust Gas Of Base Nozzle data field is mandatory. (*This data corresponds to AP98 variable **GAMJ**.*)

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that data entry is complete. After choosing the OK pushbutton, the AP98 Interface will determine if all mandatory data items have been entered.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Aeroprediction-Power-On Option Data data entry screen without processing the Aeroprediction-Power-On Options Data data.

3.2.5 Plots Data Entry Screens

3.2.5.1 Plots-Total Static Aerodynamics Data Entry Screen

The Plots-Total Static Aerodynamics data entry screen is depicted in Figure 42.

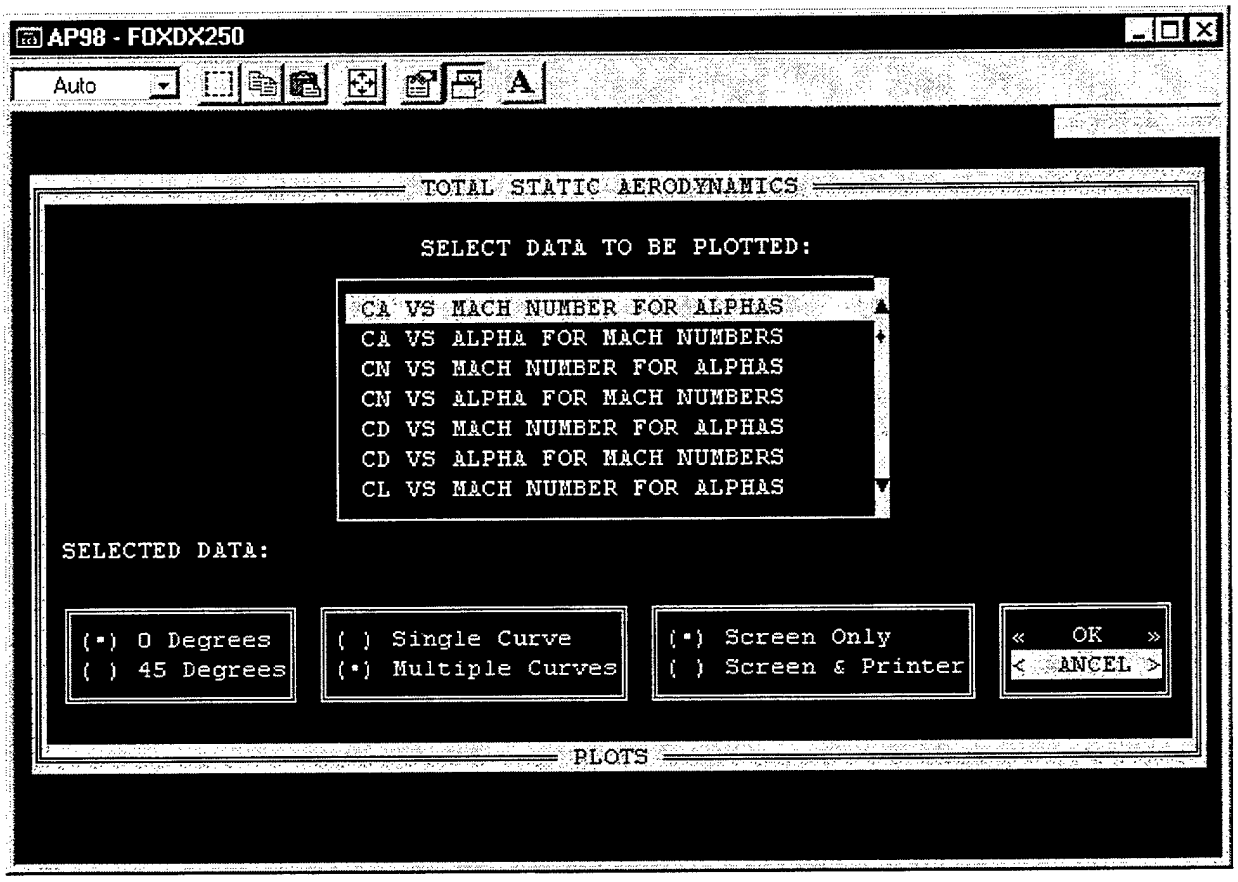


FIGURE 42. PLOTS-TOTAL STATIC AERODYNAMICS DATA ENTRY SCREEN

The Plots-Total Static Aerodynamics data entry screen consists of a list, a data field, three sets of radio buttons, and two pushbuttons to be used as follows:

Select Data To Be Plotted list—The user can choose the type of plot to be generated from this list. The choices displayed in the list will depend upon the user's choice of the free-stream conditions.

Selected Data data field—The Selected Data data field is not enabled (i.e., data cannot be entered into this field by the user). When a plot type is chosen from the Select Data To Be Plotted list, the plot type will appear in the Selected Data data field.

Roll Angle radio buttons—The Roll Angle radio buttons will be enabled only when the "Both" radio button has been selected in the Roll Angle radio-button set in the free-stream conditions and when there is a plot type displayed in the Selected Data data field. When active, the selection of either the "0 Degrees" or "45 Degrees" radio buttons will determine whether the aerodynamic coefficients to be plotted will represent the missile in the "plus" or "cross" orientation respectively. The "0 Degrees" radio button is selected as the default.

Single/Multiple Curves radio buttons—This set of radio buttons is enabled only when there is a plot type displayed in the Selected Data data field and there is more than one curve to plot.

The choice of a Single/Multiple Curves radio button is not mandatory. The "Multiple Curves" radio button is selected as the default. A brief description of each radio button is as follows:

Single Curve radio button—By selecting this radio button, the user will be able to view a series of plots, one at a time. Each plot will contain only one curve.

Multiple Curves radio button—By selecting this radio button, up to five curves per plot are allowed. The user will be able to view up to four plots, one at a time.

Screen/Printer radio buttons—The Screen/Printer radio buttons are enabled when there is a plot type displayed in the Selected Data data field. The "Screen Only" radio button is selected as the default and should be chosen when the user desires to view the plots on the screen only. In order to obtain hard copies of the plots, the user should select the "Screen & Printer" radio button.

OK pushbutton—The OK pushbutton is enabled only when there is a plot type displayed in the Selected Data data field. By choosing the OK pushbutton, you are confirming that data entry is complete.

After choosing the OK button, the selected aerodynamic data will be plotted on the screen, one plot at a time. Press any key on the keyboard to view successive plots. If the "Screen & Printer" radio button was selected, then each plot will be sent to the printer after it has been viewed on the screen. To abort a print job, hit the ESC key. After all of the data has been viewed, the user will be returned to the AP98 menu bar.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Plots-Total Static Aerodynamics data entry screen without processing the Plots-Total Static Aerodynamics data.

3.2.5.2 Plots-Aerothermal Information Data Entry Screen

The Plots-Aerothermal Information data entry screen is depicted in Figure 43.

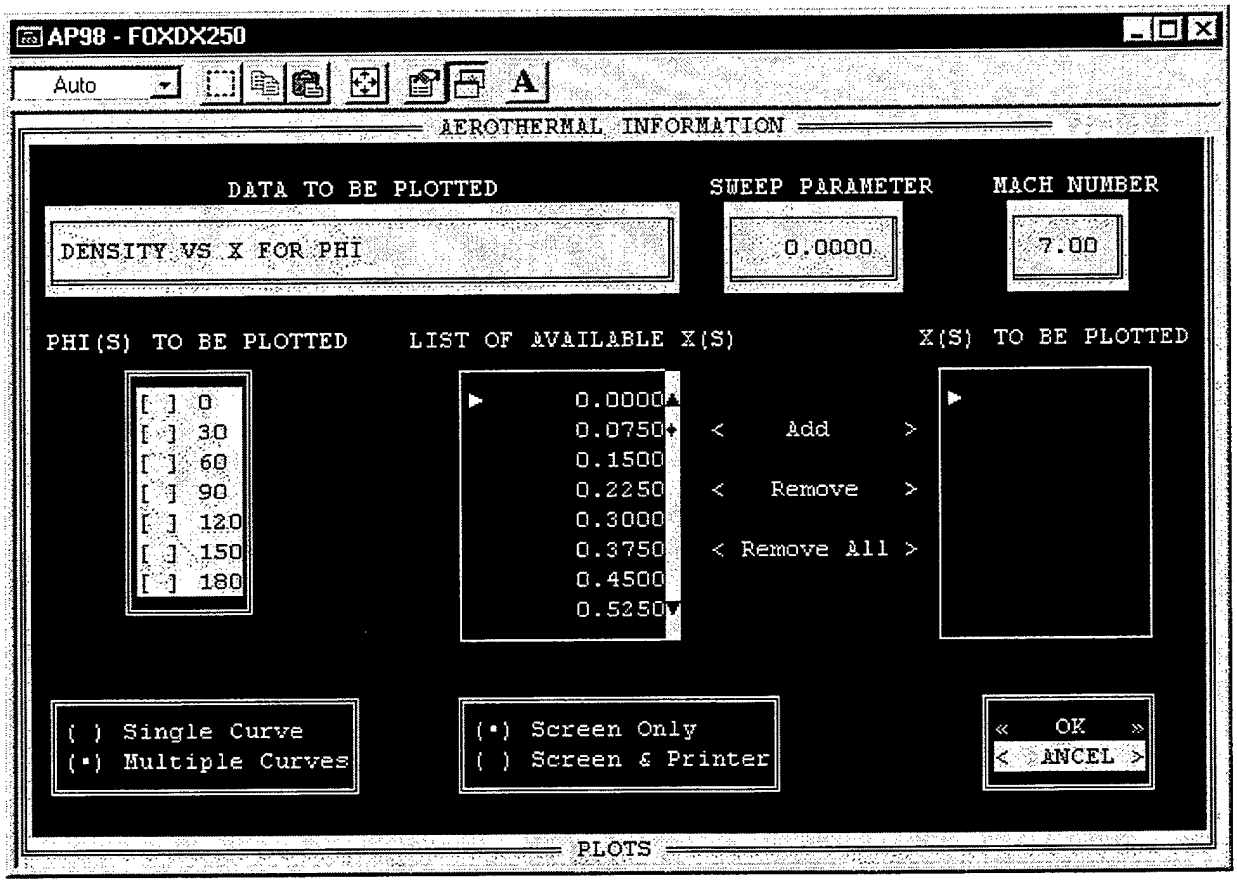


FIGURE 43. PLOTS-AEROTHERMAL INFORMATION DATA ENTRY SCREEN

The Plots-Aerothermal Information data entry screen consists of three popup controls, three sets of radio buttons, two lists, and five pushbuttons to be used as follows:

Data To Be Plotted popup control—The Data To Be Plotted popup control is always enabled. Selecting this popup control will reveal a list of aerothermal information variables that can be plotted. The variables can be plotted against the missile's longitudinal coordinate "X," or against the missile's circumferential coordinate "PHI."

Sweep Parameter popup control—The Sweep Parameter popup control is always enabled. Selecting this popup control will reveal a list of sweep parameter values that are available for plotting. The values to select from in the list will reflect the free-stream conditions entered by the user. The selection of a Sweep Parameter menu option is not mandatory. The first sweep parameter is used as the default.

Mach Number popup control—The Mach Number popup control is always enabled. Selecting this popup control will reveal a list of Mach numbers that are available for plotting. The values to select from in the list will reflect the free-stream conditions entered by the user. The selection of a Mach Number menu option is not mandatory. The first Mach number is used as the default.

PHI(S) To Be Plotted radio buttons—Whether this set of radio buttons will be enabled or not will depend upon the Data To Be Plotted menu option that is chosen. If the data is to be plotted against "X," then the PHI(S) To Be Plotted radio buttons will be enabled. Otherwise, these buttons will be deactivated. Each radio button corresponds to the circumfrential location of the data to be plotted. The "0" radio button corresponds to the top or leeward side of the missile, while the "180" radio button corresponds to the bottom or windward side of the missile. The user may select any number and combination of the radio buttons, but it is mandatory to select at least one of the radio buttons.

List Of Available X(S) list—Whether this list will be enabled or not will depend upon the Data To Be Plotted menu option that is chosen. If the data is to be plotted against "PHI," then the List Of Available X(S) list will be enabled. Otherwise, the list will be deactivated. The user may select any number and combination of the available X values in the list by using the "Add" pushbutton. The selection of at least one X value is mandatory.

Add pushbutton—The Add pushbutton will be enabled when the List Of Available X(S) list is enabled. Upon choosing the Add pushbutton, the highlighted X value in the List Of Available X(S) list will be transferred into the X(S) To Be Plotted list.

Remove pushbutton—The Remove pushbutton will be enabled when there is at least one value stored in the X(S) To Be Plotted list. Upon choosing the Remove pushbutton, the highlighted X value in the X(S) To Be Plotted list will be transferred into the List Of Available X(S) list.

Remove All pushbutton—The Remove All pushbutton will be enabled when there is at least one value stored in the X(S) To Be Plotted list. Upon choosing the Remove All pushbutton, all of the X values in the X(S) To Be Plotted list will be transferred into the List Of Available X(S) list.

X(S) To Be Plotted list—The X(S) To Be Plotted list will become enabled when X values are entered into it, and will become disabled when all of the X values are removed from it. This list contains the values of X for which the aerothermal data will be plotted. If the aerothermal data is to be plotted against PHI, then at least one value for X must be entered into the X(S) To Be Plotted list.

Single/Multiple Curves radio buttons—This set of radio buttons is enabled when there is at least one PHI(S) To Be Plotted radio button selected or when there is at least one X value entered into the X(S) To Be Plotted list. The choice of a Single/Multiple Curves

radio button is not mandatory. The "Multiple Curves" radio button is selected as the default. A brief description of each radio button is as follows:

Single Curve radio button—By selecting this radio button, the user will be able to view a series of plots, one at a time. Each plot will contain only one curve.

Multiple Curves radio button—By selecting this radio button, up to five curves per plot are allowed. The user will be able to view up to four plots, one at a time.

Screen/Printer radio buttons—The Screen/Printer radio buttons are enabled when there is at least one PHI(S) To Be Plotted radio button selected or when there is at least one X value entered into the X(S) To Be Plotted list. The "Screen Only" radio button is selected as the default and should be chosen when the user desires to view the plots on the screen only. In order to obtain hard copies of the plots, the user should select the "Screen & Printer" radio button.

OK pushbutton—The OK pushbutton is enabled when there is at least one PHI(S) To Be Plotted radio button selected or when there is at least one X value entered into the X(S) To Be Plotted list. By choosing the OK pushbutton, you are confirming that data entry is complete.

After choosing the OK button, the selected aerothermal data will be plotted on the screen, one plot at a time. Press any key on the keyboard to view successive plots. If the "Screen & Printer" radio button was selected, then each plot will be sent to the printer after it has been viewed on the screen. To abort a print job, hit the ESC key. After all of the data has been viewed, the user will be returned to the AP98 menu bar.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Plots-Aerothermal Information data entry screen without processing the Plots-Aerothermal Information data.

3.2.5.3 Plots-Structural Loading Data Entry Screen

The Plots-Structural Loading data entry screen is depicted in Figure 44.

The Plots-Structural Loading data entry screen consists of four sets of radio buttons, a list, a data field, two popup controls, and two pushbuttons to be used as follows:

Structural Component radio buttons—There are three Structural Component radio buttons: "Body", "Tail," and "Canard." Whether or not a given radio button is activated will depend upon the type of configuration that the user has specified. For example, if the user has specified a body-tail configuration, then the "Body" and "Tail" radio buttons will be enabled and the "Canard" radio button will be disabled. The selection of a radio

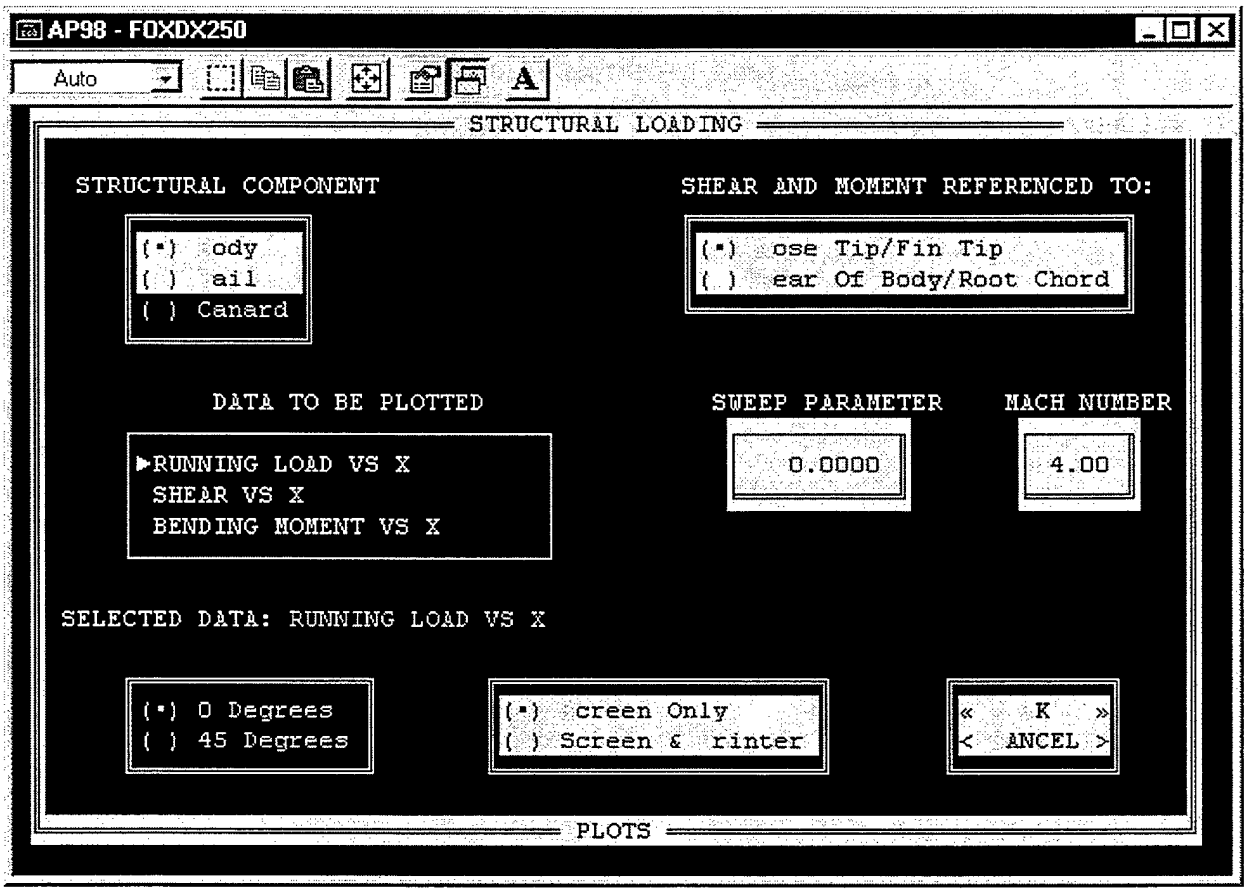


FIGURE 44. PLOTS-STRUCTURAL LOADING DATA ENTRY SCREEN

button is mandatory and should correspond to that part of the missile that will undergo structural analysis.

Shear And Moment Referenced To: radio buttons—This set of radio buttons will become enabled after the user has selected a Structural Component radio button. The selection of a radio button is mandatory and will determine where the shear and moment will be referenced to.

Data To Be Plotted list—The Data To Be Plotted list will become enabled after the user has selected a Sheer And Moment Referenced To: radio button. The selection of one of the items in the list is mandatory and will determine which data is to be plotted.

Selected Data: data field—The Selected Data: data field is never enabled. It's function is to display the selection from the Data To Be Plotted list.

Sweep Parameter popup control—The Sweep Parameter popup control is enabled after a Data To Be Plotted selection has been made. Selecting this popup control will reveal a list of sweep parameter values that are available for plotting. The values to select from in

the list will reflect the free-stream conditions entered by the user. The selection of a Sweep Parameter menu option is not mandatory. The first sweep parameter is used as the default.

Mach Number popup control—The Mach Number popup control is enabled after a Data To Be Plotted selection has been made. Selecting this popup control will reveal a list of Mach numbers that are available for plotting. The values to select from in the list will reflect the free-stream conditions entered by the user. The selection of a Mach Number menu option is not mandatory. The first Mach number is used as the default.

Roll Angle radio buttons—The Roll Angle radio buttons will be enabled after a Data To Be Plotted selection has been made and when the "Both" radio button has been selected in the Roll Angle radio-button set in the free-stream conditions. When active, the selection of either the "0 Degrees" or "45 Degrees" radio buttons will determine whether the aerodynamic coefficients to be plotted will represent the missile in the "plus" or "cross" orientation respectively. The "0 Degrees" radio button is selected as the default.

Screen/Printer radio buttons—The Screen/Printer radio buttons are enabled after a Data To Be Plotted selection has been made. The "Screen Only" radio button is selected as the default and should be chosen when the user desires to view the plots on the screen only. In order to obtain hard copies of the plots, the user should select the "Screen & Printer" radio button.

OK pushbutton—The OK pushbutton is enabled after a Data To Be Plotted selection has been made. By choosing the OK pushbutton, you are confirming that data entry is complete.

After choosing the OK button, the selected structural loading data will be plotted on the screen, one plot at a time. Press any key on the keyboard to view successive plots. If the "Screen & Printer" radio button was selected, then each plot will be sent to the printer after it has been viewed on the screen. To abort a print job, hit the ESC key. After all of the data has been viewed, the user will be returned to the AP98 menu bar.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Plots-Structural Loading data entry screen without processing the Plots-Structural Loading data.

3.2.6 Tables-Total Static Aerodynamics Data Entry Screen

The Tables-Total Static Aerodynamics data entry screen is depicted in Figure 45.

FIGURE 45. TABLES-TOTAL STATIC AERODYNAMICS DATA ENTRY SCREEN

The Tables-Total Static Aerodynamics data entry screen consists of a list, a data field, a set of radio buttons, two data fields, and two pushbuttons to be used as follows:

Select Data To Be Tabularized list—From this list, the user can select the type of AP98 output data to be incorporated into tabular form. The items found on the list will be determined by the type of free-stream sweep that the user has specified.

Roll Angle radio buttons—The Roll Angle radio buttons will be enabled only when the "Both" radio button has been selected in the Roll Angle radio-button set in the free-stream conditions. When active, the selection of either the "0 Degrees" or "45 Degrees" radio buttons will determine whether the aerodynamic coefficients to be tabulated will represent the missile in the "plus" or "cross" orientation respectively. The "0 Degrees" radio button is selected as the default.

Selected Data data field—The Selected Data data field is not enabled (i.e., data cannot be entered into this field by the user). When a table type is chosen from the Selected Data To Be Tabularized list, the table type will appear in the Selected Data data field.

Enter Complete DOS Filename, Including Extension data field—The Enter Complete DOS Filename, Including Extension data field becomes enabled after a table type is selected in the Selected Data data field. The user should enter a DOS filename that is to contain the specified data. The specification of a DOS filename is mandatory.

OK pushbutton—The OK pushbutton is enabled after a DOS filename has been entered into the Enter Complete DOS Filename, Including Extension data field. By choosing the OK pushbutton, you are confirming that the table type displayed in the Selected Data data field is the desired table type.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Tables-Total Static Aerodynamics data entry screen without processing Tables-Total Static Aerodynamics data.

3.2.7 Printer Data Entry Screens

3.2.7.1 Aeroprediction-AP98 Output File Printer Selection Data Entry Screen

The Aeroprediction-AP98 Output File Printer Selection data entry screen is depicted in Figure 46.

The Aeroprediction-Printer Selection data entry screen consists of a list, a data field, and two pushbuttons to be used as follows:

Select Printer list—From this list, the user can select the type of printer to be used to generate hard copies of the AP98 output files.

Current Printer data field—The Current Printer data field is not enabled (i.e., data cannot be entered into this field by the user). When a printer type is chosen from the Select Printer list, the printer type will appear in the Current Printer data field.

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK push-button, you are confirming that the printer type displayed in the Current Printer data field is the desired printer.

Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel push-button to leave the Aeroprediction-AP98 Output File Printer Selection data entry screen without processing the AP98 Output File Printer Selection data.

FIGURE 46. AEROPREDICTION-AP98 OUTPUT FILE PRINTER SELECTION DATA ENTRY SCREEN

3.2.7.2 Aeroprediction-Geometry Sketch/Plots Printer Selection Data Entry Screen

The Aeroprediction-Geometry Sketch/Plots Printer Selection data entry screen is depicted in Figure 47.

The Aeroprediction-Geometry Sketch/Plots Printer Selection data entry screen consists of a set of radio buttons, a list, a data field, and two pushbuttons to be used as follows:

Select Printer Type: radio buttons—From this set of radio buttons, the user can select the type of printer to be used to generate hard copies of geometry sketches or plots.

Select Dot-Matrix Or Ink-Jet Printer: list—This list will be enabled when the "Dot-Matrix or Ink-Jet" radio button is selected. From this list, the user can select the type of Dot-Matrix or Ink-Jet printer to be used to generate hard copies of geometry sketches or plots.

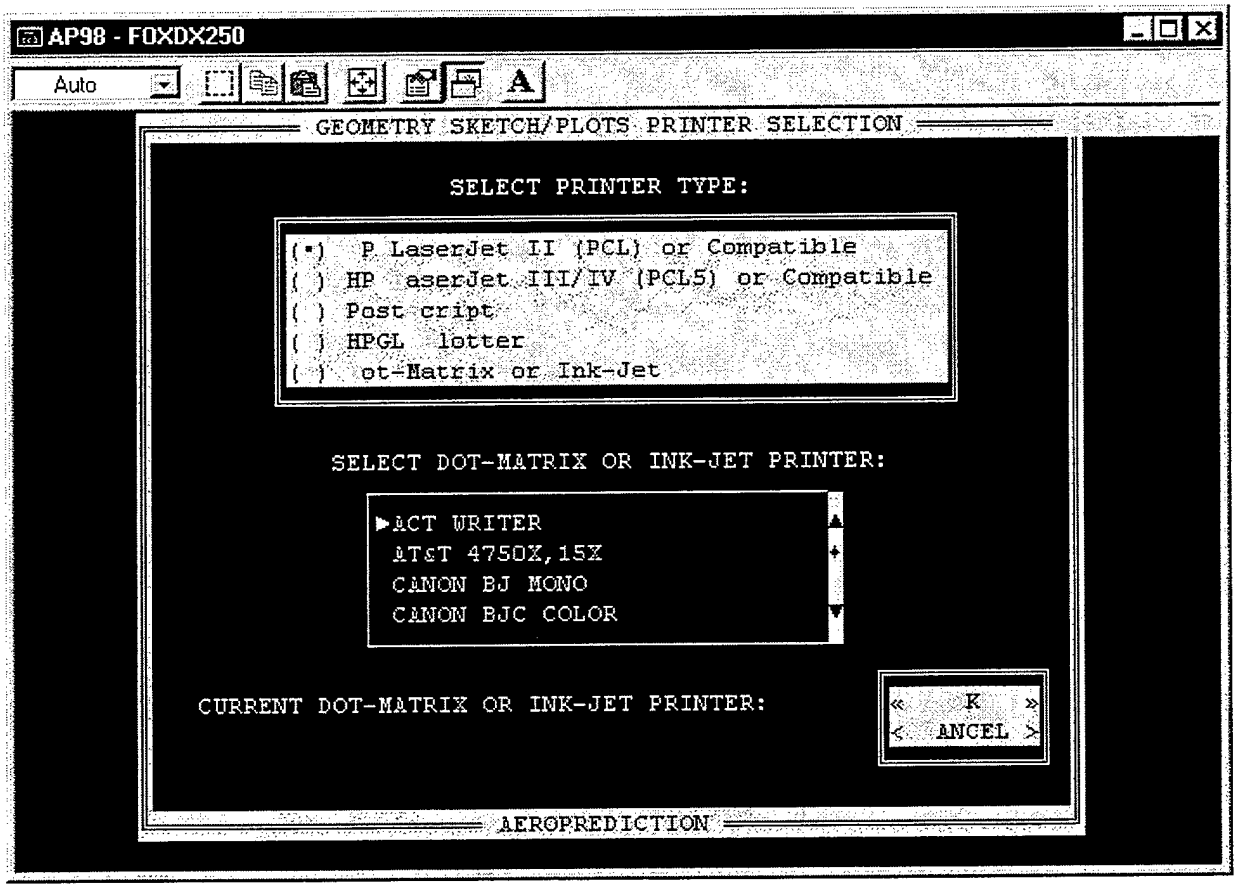


FIGURE 47. AEROPREDICTION-GEOMETRY SKETCH/PLOTS PRINTER SELECTION DATA ENTRY SCREEN

Current Dot-Matrix Or Ink-Jet Printer data field—The Current Dot-Matrix Or Ink-Jet Printer data field is not enabled (i.e., data cannot be entered into this field by the user). When a Dot-Matrix or Ink-Jet printer type is chosen from the Select Dot-Matrix Or Ink-Jet Printer list, the printer type will appear in the Current Dot-Matrix Or Ink-Jet Printer data field.

OK pushbutton—The OK pushbutton is always enabled. By choosing the OK pushbutton, you are confirming that the printer type selected in the Select Printer Type: radio-button set is the desired printer.

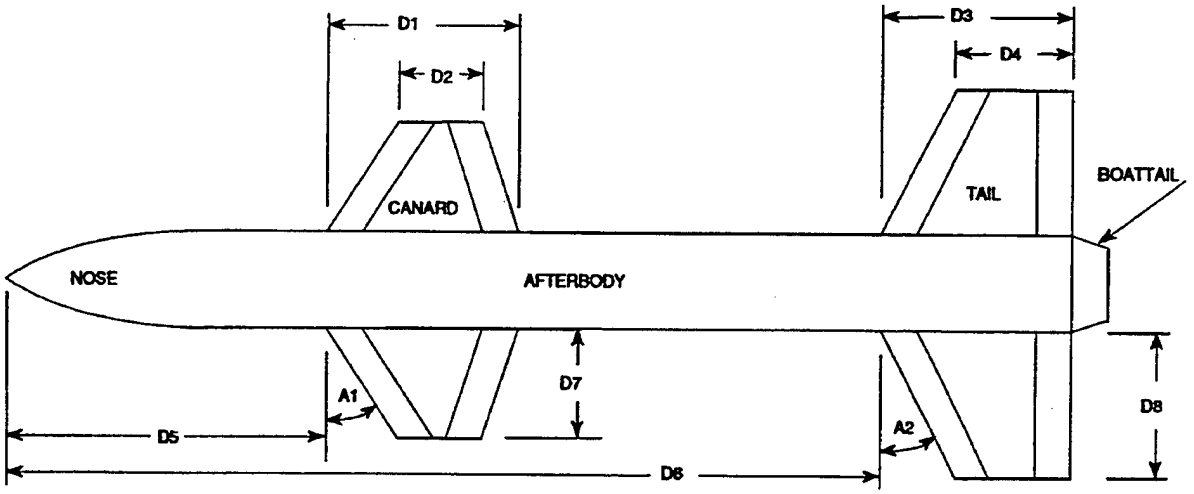
Cancel pushbutton—The Cancel pushbutton is always enabled. Choose the Cancel pushbutton to leave the Aeroprediction-Geometry Sketch/Plots Printer Selection data entry screen without processing the Geometry Sketch/Plots Printer Selection data.

CHAPTER 4

AUTOMATED GEOMETRY AND ALIMIT COMPUTATION

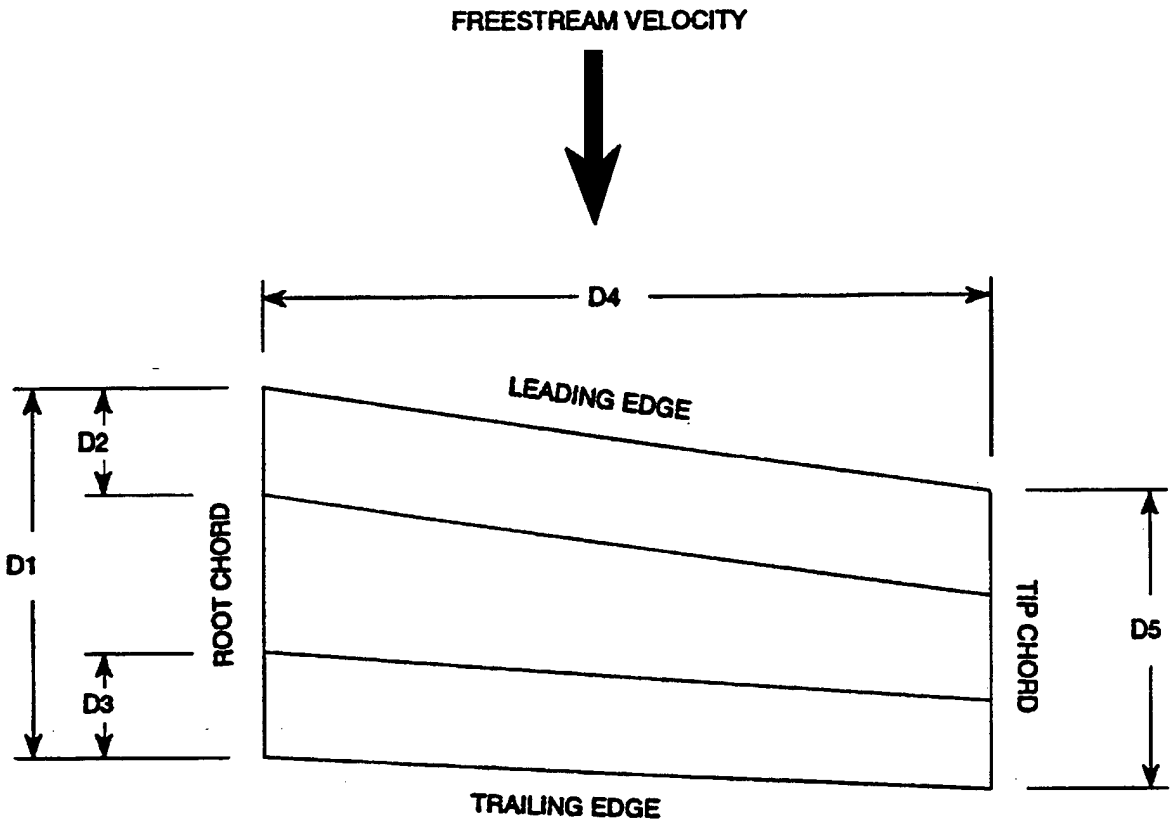
4.1 GEOMETRY REFERENCE

This section contains figures that show the physical significance of some of the input geometry parameters. The figures also define the missile components. For each dimension shown in the figures, there is a corresponding variable name that is used in the AP98 source code. Figure 48 contains a sketch of a generic wing-body-tail geometry and its associated dimensions. The dimensions for a double-wedge fin planform are shown in Figure 49, and sectional views of the fin at the root and tip chord are shown in Figure 50. Figure 51 shows the difference between a "standard" afterbody and a multisectioned "non-standard" afterbody.



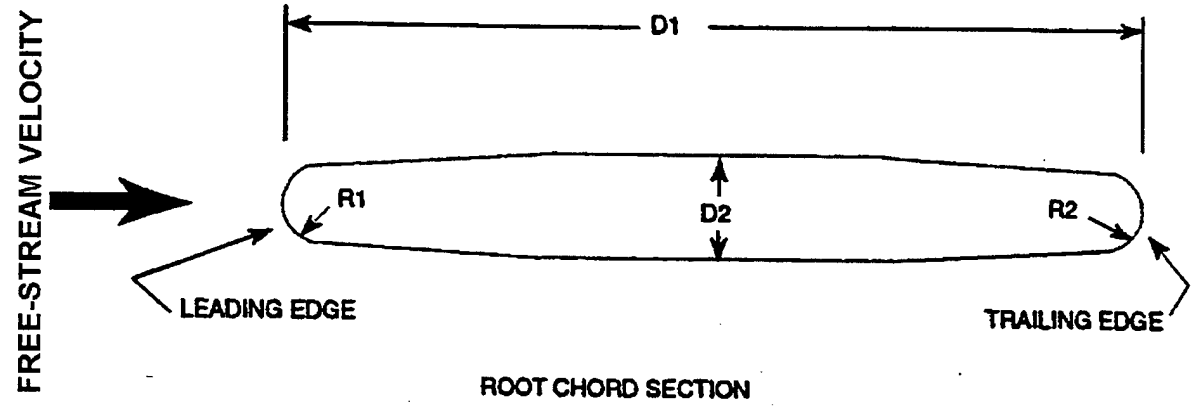
DIMENSION	AP98 INTERFACE DEFINITION	AP98 SOURCE CODE VARIABLE NAME
D1	(CANARD) ROOT CHORD	CRC
D2	(CANARD) TIP CHORD	CTC
D3	(TAIL) ROOT CHORD	CRW
D4	(TAIL) TIP CHORD	CTW
D5	DISTANCE OF CANARD LEADING EDGE FROM NOSE TIP	XC
D6	DISTANCE OF TAIL LEADING EDGE FROM NOSE TIP	XW
D7	(CANARD) SEMISPAN	BC/2
D8	(TAIL) SEMISPAN	BW/2
A1	(CANARD) LEADING EDGE SWEEP ANGLE	GAC1
A2	(TAIL) LEADING EDGE SWEEP ANGLE	GAW1

FIGURE 48. GENERIC WING-BODY-TAIL CONFIGURATION AND NOMENCLATURE

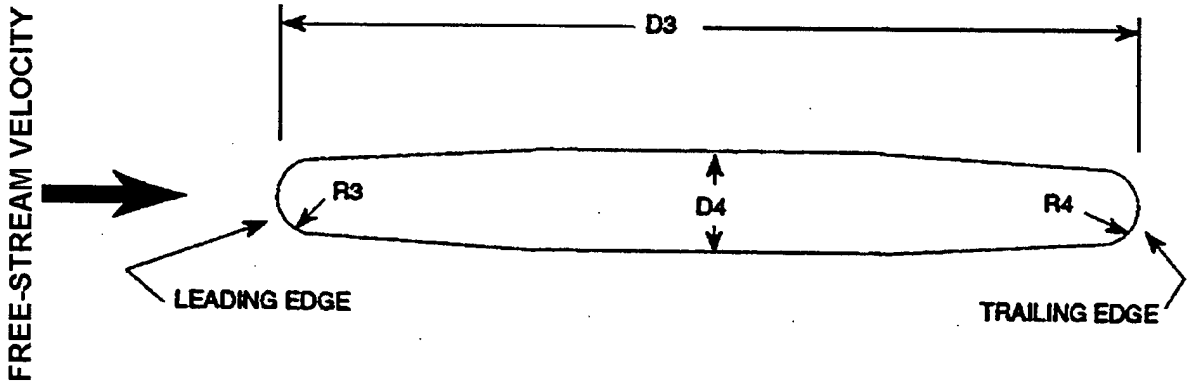


DIMENSION	AP98 INTERFACE DEFINITION	AP98 SOURCE CODE VARIABLE NAME
D1	ROOT CHORD	CRW
D2	DISTANCE FROM LEADING EDGE TO FIRST DISCONTINUITY DOWNSTREAM AT THE ROOT CHORD	CR1W
D3	DISTANCE FROM TRAILING EDGE TO FIRST DISCONTINUITY UPSTREAM AT THE ROOT CHORD	CR2W
D4	SEMISPAN	BW/2
D5	TIP CHORD	CTW

FIGURE 49. GENERIC WING HALF SPAN AND ASSOCIATED NOMENCLATURE



ROOT CHORD SECTION



TIP CHORD SECTION

DIMENSION	AP98 INTERFACE DEFINITION	AP98 SOURCE CODE VARIABLE NAME
D1	ROOT CHORD	CRW
D2	THICKNESS AT ROOT CHORD	TRW
D3	TIP CHORD	CTW
D4	THICKNESS AT TIP	TTW
R1	LEADING EDGE CYLINDRICAL RADIUS AT ROOT CHORD	RRW
R2	TRAILING EDGE CYLINDRICAL RADIUS AT ROOT CHORD	RTEW
R3	LEADING EDGE RADIUS AT TIP	RTW
R4	TRAILING EDGE RADIUS AT TIP	RTEW1

FIGURE 50. GENERIC WING CROSS SECTION AND ASSOCIATED NOMENCLATURE

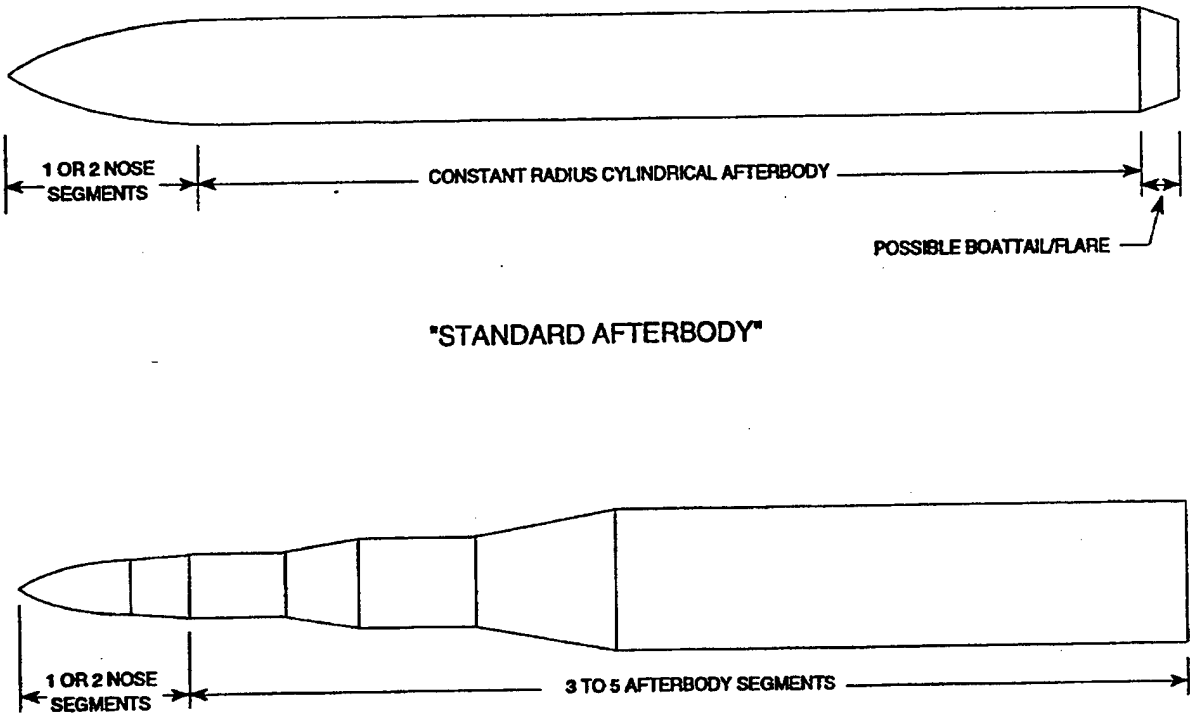


FIGURE 51. STANDARD AND MULTISECTIONED AFTERBODY NOMENCLATURE

4.2 TABLE LOOKUPS

This section contains the table that is used to look up the free-stream pressure, temperature, and Reynolds Number/Mach/Foot as a function of altitude. Table 2 gives this information.

4.3 AUTOMATIC ALIMIT COMPUTATION

This section discusses a new capability that has been added to the AP98 code to compute the parameter ALIMIT automatically. ALIMIT is defined as the Mach number above which a Second Order Shock Expansion methodology is used to compute body-alone inviscid static aerodynamics.

TABLE 2. VARIATION OF FREE-STREAM PRESSURE, TEMPERATURE, AND REYNOLDS NUMBER/MACH/FOOT WITH ALTITUDE

(Taken from 1966 U.S. Standard Atmosphere Tables, Midlatitude (30°- 60°N), Spring/Fall)

ALTITUDE (Kft)	PINF PRESSURE (lb/ft^2)	TINF TEMPERATURE (°R)	$\frac{Re}{Mft} = \frac{\rho a}{\mu}$
0	2116.22	518.69	7.1007×10^{6}
10	1455.60	483.04	5.3854×10^{6}
20	973.27	447.43	3.9754×10^{6}
30	629.66	411.86	2.8696×10^{6}
40	393.13	389.99	1.9207×10^{6}
50	243.61	389.99	1.1878×10^{6}
60	151.03	389.99	7.3456×10^{5}
70	93.73	389.99	4.5549×10^{5}
80	58.51	397.72	2.8235×10^{5}
90	36.78	403.17	1.7544×10^{5}
100	23.27	408.6	1.0854×10^{5}
110	14.84	418.41	6.399×10^{4}
120	9.60	433.61	3.9315×10^{4}
130	6.31	448.79	2.458×10^{4}
140	4.21	463.95	1.5633×10^{4}
150	2.84	479.1	1.0084×10^{4}
160	1.94	487.2	6.7367×10^{3}
170	1.33	487.2	4.585×10^{3}
180	1.06	478.58	3.1953×10^{3}
190	0.87	467.8	2.2129×10^{3}
200	0.71	457.03	1.5202×10^{3}
210	0.27	437.74	1.0623×10^{3}
220	0.18	416.24	7.2984×10^{2}
230	0.11	394.76	4.8844×10^{2}
240	0.07	373.3	3.1712×10^{2}
250	0.04	351.86	2.0205×10^{2}

Figure 52 shows the percent error in the drag coefficient, CD, as a function of Similarity parameter, K, for various methodologies. In an effort to minimize the error in CD, the Second Order Shock Expansion method is used for Similarity parameters above 1.2, and the Conical Shock Expansion method is used for Similarity parameters below 1.2. An expression for the Mach number at which the switch in these methodologies takes place in terms of the nose length, L, is given by

$$ALIMIT = 1.2L \tag{1}$$

The parameter ALIMIT is bounded by the constraints:

$$1.6 < ALIMIT < 3.0 \tag{2}$$

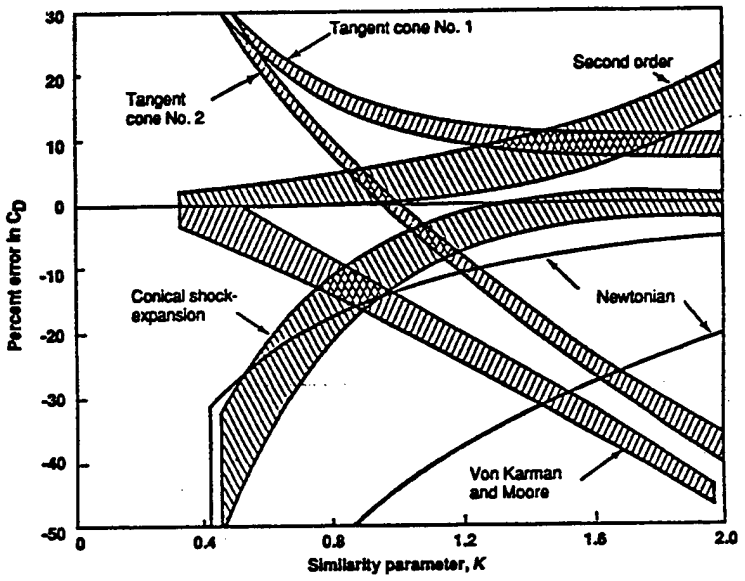


FIGURE 52. ACCURACY OF VARIOUS METHODS FOR ESTIMATING PRESSURE DRAG OF NONSLENDER NOSES AT ZERO ANGLE OF ATTACK (TAKEN FROM REFERENCE 3)

4.4 EQUATIONS FOR GENERATION OF NOSE POINTS

This section contains the equations used for the generation of nose point coordinates. The equations for the Von Karman Ogive, Haack Series, and Power Series noses were taken from Reference 4. The equations for the Tangent Ogive, Secant Ogive, and Cone are derived.

Given the required dimensions of a particular nose shape, the AP98 Interface will use the appropriate equation to compute the nose point coordinates. To ensure adequate smoothness, a set of 10 nose point coordinates are computed and used as input to AP98. For truncated and blunted noses, the coordinates of the first point are set equal to (0, cap radius). A spherical nose cap is generated automatically by AP98.

4.4.1 Tangent Ogive Nose

The shape of a Tangent Ogive nose is defined as shown in Figure 53. It consists of a circular arc whose last point is tangent to the top of the circle. The origin in Figure 53 coincides with the tip of the nose. The radius of curvature of the nose, ρ, may be found as follows:

From geometry,

$$(\rho - R)^2 + L^2 = \rho^2 \tag{3}$$

Expanding Equation (3),

$$\rho^2 - 2\rho R + R^2 + L^2 = \rho^2 \tag{4}$$

Solving for ρ,

$$\rho = \frac{R^2 + L^2}{2R} \tag{5}$$

The distance y as a function of x for a circle centered at (h, k) is given by

$$\rho^2 = (x - h)^2 + (y - k)^2 \tag{6}$$

Solving Equation (6) for y,

$$y = \sqrt{\rho^2 - (x - h)^2} + k \tag{7}$$

Noting that h = L and that k = R - ρ, Equation (7) becomes

$$y = \sqrt{\rho^2 - (x - L)^2} + (R - \rho) \tag{8}$$

The length of the nose, L, and the diameter of the nose, 2R, are supplied by the user. Given L and R, one can use Equation (5) to solve for ρ. The nose point coordinates can then be found by solving Equation (8), where x is varied from 0 to L.

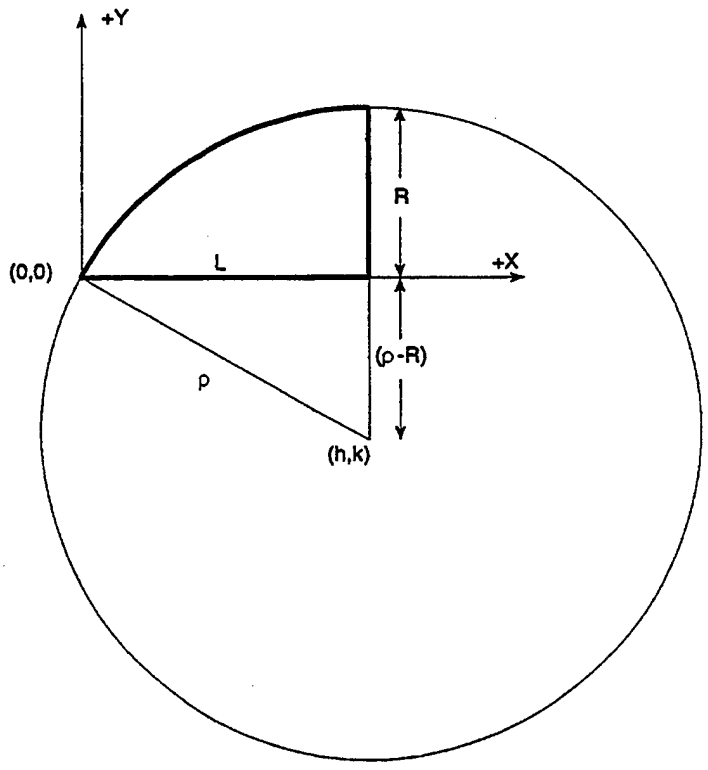


FIGURE 53. TANGENT OGIVE NOSE NOMENCLATURE

4.4.2 Secant Ogive Nose

The shape of a Secant Ogive nose is defined as shown in Figure 54. It is similar to the Tangent Ogive nose with the exception that the last point does not coincide with the top of the circle. The origin in Figure 54 is located at the tip of the nose. The length of the nose, L, the diameter of the nose, 2R, and the radius of curvature, ρ, are supplied by the user. An equation for the nose point coordinates is derived from the equation of a circle centered at (h, k):

$$\rho^2 = (x - h)^2 + (y - k)^2 \tag{9}$$

Solving Equation (9) for y,

$$y = \sqrt{\rho^2 - (x-h)^2} + k \tag{10}$$

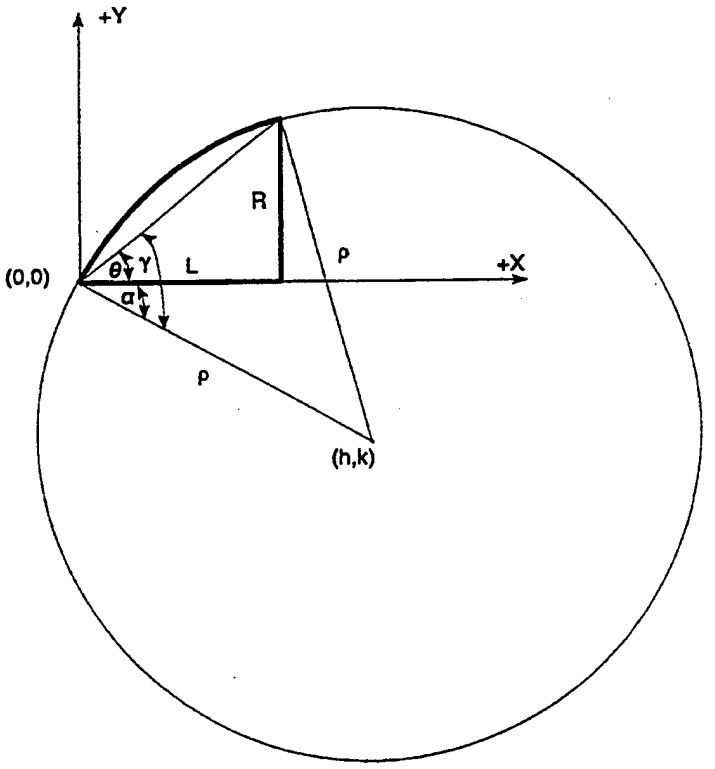


FIGURE 54. SECANT OGIVE NOSE NOMENCLATURE

Referring to Figure 54, the coordinates of the center of the circle are found from

$$h = \rho \cos \alpha \tag{11}$$

$$k = \rho \sin \alpha \tag{12}$$

where

$$\alpha = \gamma - \theta \tag{13}$$

and

$$\theta = \tan^{-1}\left(\frac{R}{L}\right) \tag{14}$$

The angle γ is found using the law of cosines:

$$\rho^2 = (L^2 + R^2) + \rho^2 - 2\rho\sqrt{L^2 + R^2}\cos\gamma \tag{15}$$

Solving for γ,

$$\gamma = \cos^{-1}\left(\frac{\sqrt{L^2 + R^2}}{2\rho}\right) \tag{16}$$

After solving for h and k given L, R, and ρ, the nose point coordinates can be found by solving Equation (10), where x is varied from 0 to L.

4.4.3 Haack Series Nose

The equation for a Haack Series nose is given in Reference 5 as

$$r = \frac{1}{\sqrt{\pi}}\sqrt{\phi - \frac{1}{2}\sin 2\phi + C\sin^3\phi} \tag{17}$$

where

x = distance from nose station/total nose length
r = radius at any nose station/radius at base of the nose

The quantity θ is given by

$$\phi = \cos^{-1}(1 - 2x) \tag{18}$$

For a Haack Series nose, the constant C = 1/3.

The nose point coordinates can be found by solving Equation (17), where x is varied from 0 to 1.0. Note that x and r have been non-dimensionalized by the total nose length, L, and the radius at the base of the nose, R, respectively. The dimensions L and R are supplied by the user.

4.4.4 Von Karman Ogive Nose

The equation for a Von Karman nose is the same as the equation for the Haack Series nose with the exception that the constant C is equal to zero. Thus, Equation (17) for the Haack Series nose becomes

$$r = \frac{1}{\sqrt{\pi}} \sqrt{\phi - \frac{1}{2} \sin 2\phi} \tag{19}$$

where

x = distance from nose station/total nose length
r = radius at any nose station/radius at base of the nose

The quantity ϕ is given by Equation (18). The nose point coordinates can be found by solving Equation (19), where x is varied from 0 to 1.0. Note that x and r have been non-dimensionalized by the total nose length, L, and the radius at the base of the nose, R, respectively. The dimensions L and R are supplied by the user.

4.4.5 Power Series Nose

The equation for a Power Series nose is given in Reference 5 as

$$r = x^n \tag{20}$$

where

x = distance from nose station/total nose length
r = radius at any nose station/radius at base of the nose
n = an exponent between 0 and 1

The nose point coordinates can be found by solving Equation (20), where x is varied from 0 to 1.0. Note that x and r have been non-dimensionalized by the total nose length, L, and the radius at the base of the nose, R, respectively. The dimensions L and R, as well as the exponent n are supplied by the user.

4.4.6 Conical Nose

A conical nose having a half angle, θ, is shown in Figure 55. The diameter of the nose, 2R, and either the nose half angle, θ, or the length of the nose, L, are supplied by the user. If the length of the nose, L, is given, then θ is computed from Equation (21):

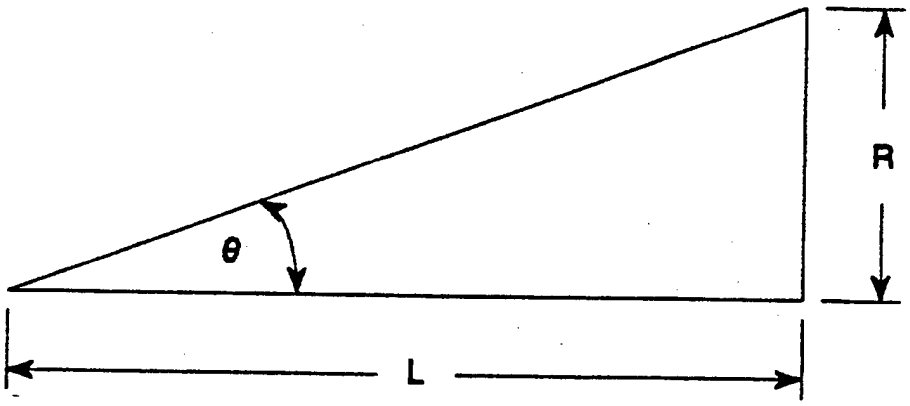


FIGURE 55. CONICAL NOSE NOMENCLATURE

$$\theta = \tan^{-1}\left(\frac{R}{L}\right) \tag{21}$$

The distance y as a function of x is then given by

$$y = x \tan \theta \tag{22}$$

The nose point coordinates can then be found by solving Equation (22), where x is varied from 0 to L.

4.4.7 Hemispherical Nose

The nose point coordinates used as input to AP98 for a hemispherical nose are always the same. They are (in calibers):

X(1) = 0.00, Y(1) = 0.4991271
X(2) = 0.05, Y(2) = 0.5

These two points represent a short conical frustum nose section having a 0.05 caliber length and an arbitrarily selected 1-degree slope.

4.5 ALTER PLANFORM UTILITY

In a continuing effort to enhance the user friendliness of the Aeroprediction code, a utility has been incorporated into the AP98 Interface that will allow the user to rapidly modify lifting surface planform shapes so that they are compatible with the required AP98 data input constraints. This section includes a description of the methods that are used for altering the fin planform, as

well as a technical discussion on how the utility works. An example case and a list of symbols are given at the end of this section.

4.5.1 Method for Altering Fin Planforms

The AP98 code requires that the fin root and tip chords are continuous and are parallel to the missile centerline. In order to meet these requirements, it is sometimes necessary to modify the actual fin planform shape. In order to minimize the deviation in predicted aerodynamics due to any modifications, several fin parameters must be held constant. These parameters include the fin surface area, span, aspect ratio, area centroid, and leading edge sweep angle. The user may choose from one of two methods that will conserve these parameters.

In the first method, the fin surface area, span, aspect ratio, area centroid, leading edge sweep angle, and trailing-edge sweep angle are conserved. This is achieved by allowing the root chord and tip chords to vary. Figure 56 depicts a generic fin that is compatible with AP98. (i.e., the root and tip chords are continuous and are parallel to the missile centerline.) The planform area of the fin is given by Equation (23), and the tip chord is given by Equation (24).

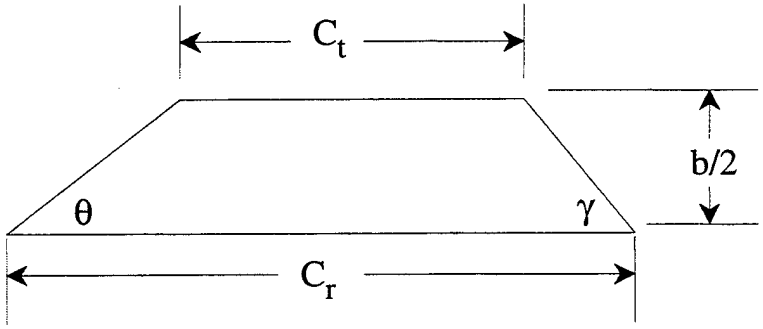


FIGURE 56. AP95 COMPATIBLE FIN

$$A_w = \frac{1}{2}\left(\frac{\frac{b}{2}}{\tan\theta}\right)\frac{b}{2} + C_t\frac{b}{2} + \frac{1}{2}\left(\frac{\frac{b}{2}}{\tan\gamma}\right)\frac{b}{2} \tag{23}$$

$$C_t = C_r - \frac{\frac{b}{2}}{\tan\theta} - \frac{\frac{b}{2}}{\tan\gamma} \tag{24}$$

These equations lead to expressions for the root and tip chord as functions of the known original planform parameters that are to be conserved.

$$C_r = 2\frac{A_w}{b} + \frac{b}{4}\left(\frac{1}{\tan}\theta + \frac{1}{\tan}\gamma\right) \tag{25}$$

$$C_t = C_r - \frac{b}{2}\left(\frac{1}{\tan}\theta + \frac{1}{\tan}\gamma\right) \tag{26}$$

In the second method, the fin surface area, span, aspect ratio, area centroid, leading-edge sweep angle, and taper ratio are conserved. This is achieved by allowing the root chord, tip chord, and trailing-edge sweep angle to vary. The planform area of the fin in Figure 56 may also be expressed as

$$A_w = b\left(\frac{C_t + C_r}{4}\right) \tag{27}$$

The taper ratio is given by

$$\lambda = \frac{C_t}{C_r} \tag{28}$$

Substituting Equation (28) into Equation (27) and solving for the root chord gives

$$C_r = 4\frac{A_w}{b(\lambda + 1)} \tag{29}$$

Solving Equation (24) for γ,

$$\gamma = \tan^{-1}\left(\frac{\frac{b}{2}}{C_r - C_t - \frac{\frac{b}{2}}{\tan\theta}}\right) \tag{30}$$

Thus, the root chord, tip chord, and trailing edge sweep angle may be found as a function of the known original planform parameters by using, sequentially, Equations (29), (28), and (30).

4.5.2 How the Utility Works

Figure 57 shows an arbitrary fin planform that happens to be situated on top of a flare. (The equations presented here also apply when the fin lies over a boattail or a right circular cylinder.) The user is required to input the coordinates of the points that describe the outer shape of the fin, including the two points where the outer edge meets the missile body. The first point is always (0,0). There should be a point for each discontinuity in the outer edge. The user is also required to

input the axial distance from the missile nose tip to the first point. If the Y coordinate of the last point is not 0, then the utility will assume that the fin lies over either a boattail or a flare. In this case, the user will be prompted to enter the axial distance from the first point to the beginning of the boattail/flare. If the boattail/flare begins before the fin, a negative distance should be entered.

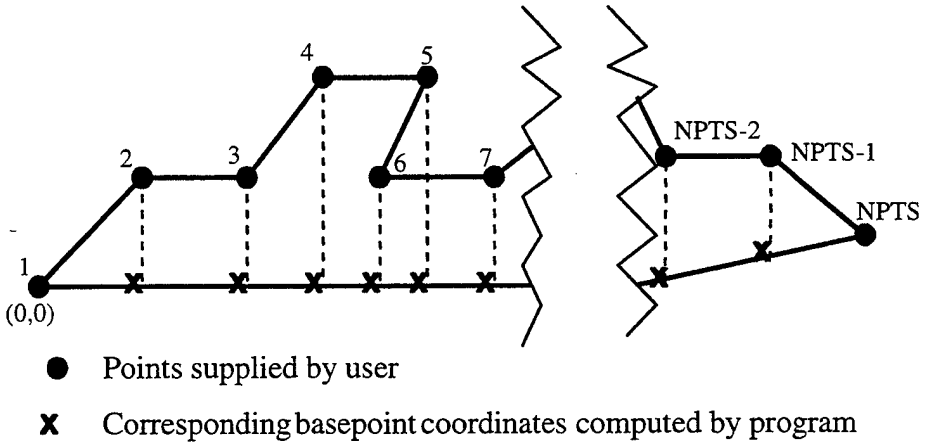


FIGURE 57. MODELING OF GENERAL FIN PLANFORM REQUIRING MODIFICATION

The program first computes the unmodified fin surface area, area centroid, and span. This is done by breaking the fin into NPTS-1 segments. Figure 58 shows the general shape of one of these segments. The surface area and area centroid of each segment can be computed numerically from Equations (31) and (32) respectively.

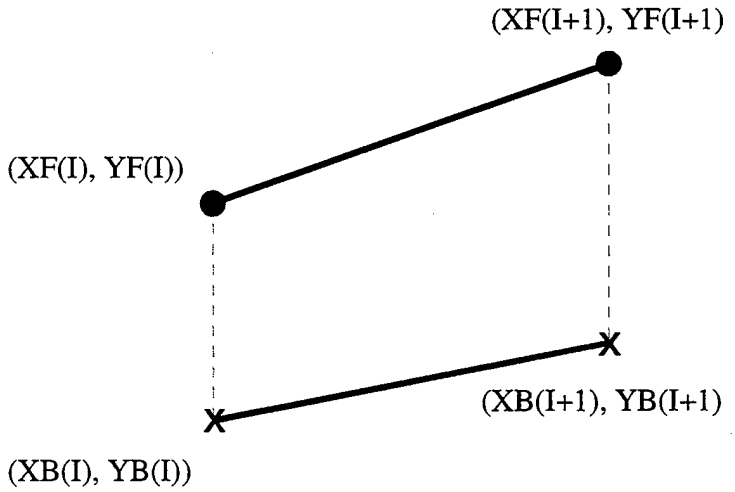


FIGURE 58. SEGMENT COORDINATES

$$A_{seg} = \left(\frac{YF(I) - YB(I) + YF(I+1) - YB(I+1)}{2}\right)(XF(I+1) - XF(I)) \tag{31}$$

$$\bar{C}_{seg} = XF(I) + \left(\frac{2(YF(I+1) - YB(I+1)) + YF(I) - YB(I)}{YF(I) + YF(I+1) - YB(I) - YB(I+1)}\right)\left(\frac{XF(I+1) - XF(I)}{3}\right) \tag{32}$$

The total fin surface area is found by summing the areas of each segment.

$$A_W = \sum_{I=1}^{NPTS-1}\left(\frac{YF(I) - YB(I) + YF(I+1) - YB(I+1)}{2}\right)(XF(I+1) - XF(I)) \tag{33}$$

In a similar fashion, the area centroid may be computed from

$$\bar{C}_w = \frac{\sum_{I=1}^{NPTS-1} \bar{C}_{seg} A_{seg}}{A_w} \tag{34}$$

As the program moves from segment to segment of the fin, it keeps track of the maximum difference YF(I) – YB(I). This maximum difference represents the fin semispan. The aspect ratio of the unmodified fin may then be found from

$$AR = \frac{b^2}{2A_w} \tag{35}$$

Given the user inputs, the program then computes the unmodified fin leading and trailing edge sweep angles. These angles are computed numerically from the user specified points numbered 1, 2, NPTS-1, and NPTS as follows:

$$\lambda_{L.E.} = 90 - \tan^{-1}\left(\frac{YF(2) - YF(1)}{XF(2) - XF(1)}\right) \tag{36}$$

$$\lambda_{T.E.} = -90 - \tan^{-1}\left(\frac{YF(NPTS) - YF(NPTS-1)}{XF(NPTS) - XF(NPTS-1)}\right) \tag{37}$$

The user is given the opportunity to verify or modify these angles. Next, the program computes the modified fin root and tip chords, and possibly the modified fin taper ratio and trailing edge sweep angle, depending upon which of the two methods described above the user selects from. These values are found by using Equations (25) and (26) or Equations (28), (29), and (30). Note that in Equation (26), it is possible to end up with a negative value for the tip chord. If the program encounters this, the user will be warned, the tip chord will be set to zero, a new root chord will be computed from Equation (38), and the trailing-edge sweep angle will be changed according to Equation (39).

$$C_r = \frac{4A_W}{b} \tag{38}$$

$$\gamma = \tan^{-1}\left(\frac{\frac{b}{2}}{C_r - \frac{\frac{b}{2}}{\tan\theta}}\right) \tag{39}$$

The program then computes the four coordinates that describe the modified fin planform.

$XF_{NEW}(1) = 0.0$
$YF_{NEW}(1) = 0.0$
$XF_{NEW}(2) = b/2\tan(\theta)$
$YF_{NEW}(2) = b/2$
$XF_{NEW}(3) = C_r - b/2\tan(\gamma)$
$XF_{NEW}(4) = C_r$
$YF_{NEW}(4) = 0.0$

Given the four new coordinates, the program is able to compute the modified fin surface area, semispan, aspect ratio, and area centroid in the same fashion as that of the unmodified fin.

Finally, the program computes the axial distance from the missile nose tip to the first point of the modified fin using Equation (40). As shown in Figure 59, this is accomplished by forcing the axial location of the modified fin area centroid to coincide with the unmodified fin area centroid axial location.

$$X_{L.E._{new}} = X_{L.E._{old}} + \left(\overline{C}_{old} - \overline{C}_{new}\right) \tag{40}$$

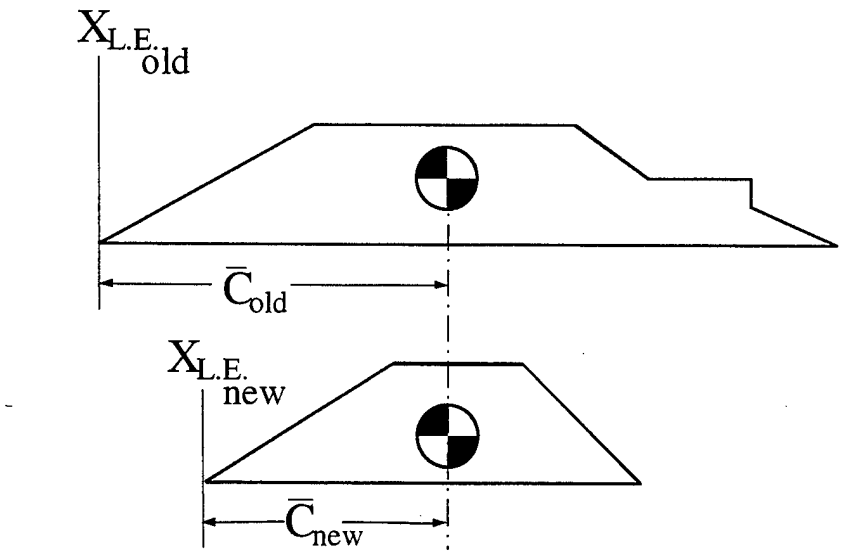


FIGURE 59. MAINTAINING THE AREA CENTROID AXIAL LOCATION

4.5.3 Example Case

Figure 60 shows a hypothetical lifting surface that must be modified before running AP98. The figure shows the axial station of each discontinuity along the outer edge of the fin. Note that these axial stations are referenced to the nose tip of the missile. Figure 60 also shows the unmodified dimensions in span. The Canard/Wing Geometry-Alter Planform data entry screen, shown in Figure 61, depicts the inputs required based upon the dimensions given in Figure 60. In this case, there are seven points which have been input as X,Y coordinate pairs. Note that the coordinates are now referenced to the beginning of the fin. The axial distance from the missile nose tip to the first point has also been input.

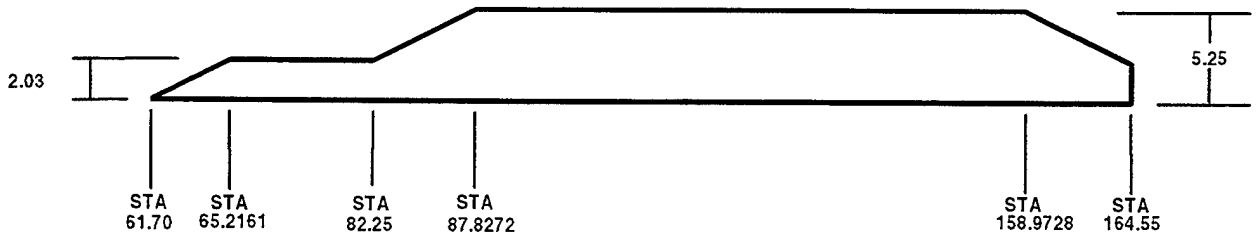


FIGURE 60. LIFTING SURFACE USED IN EXAMPLE CASE

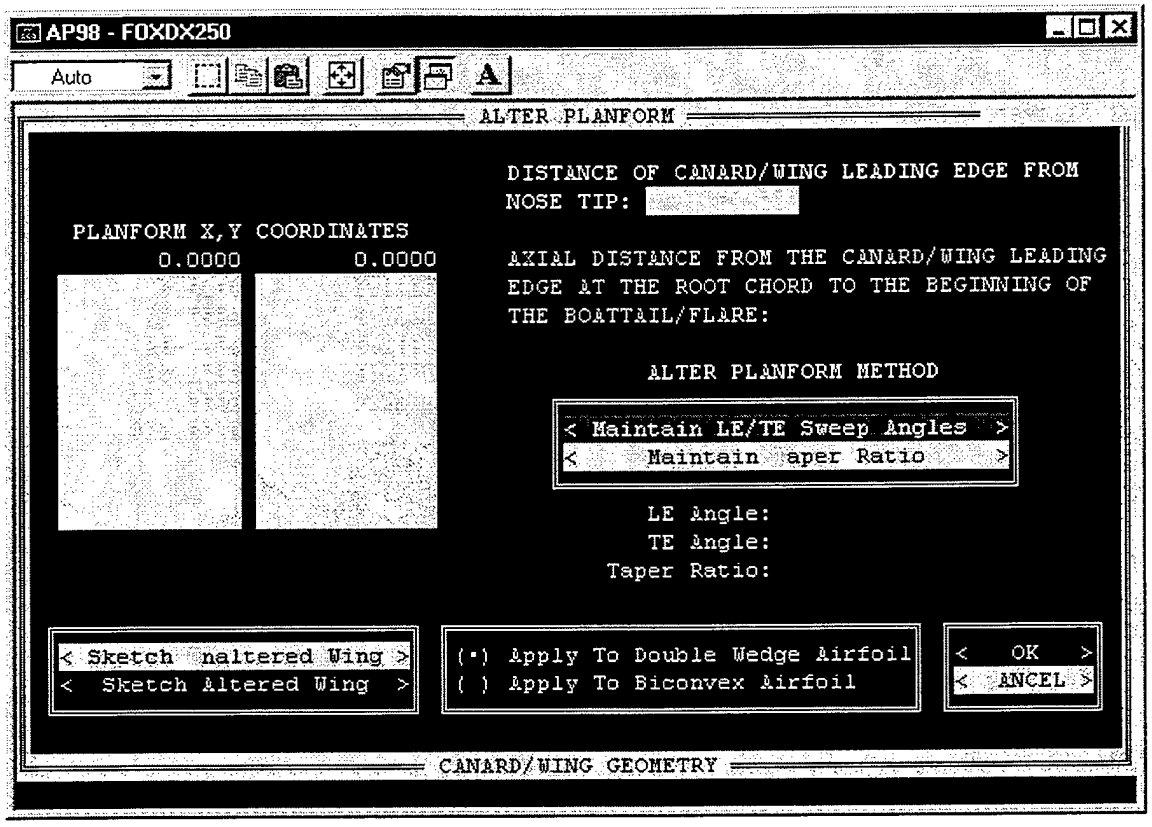


FIGURE 61. REQUIRED INPUTS FOR MODELING FIN IN EXAMPLE CASE

The modified fin is shown in Figure 62. Figure 63 is an output file that compares the modified and unmodified fins.

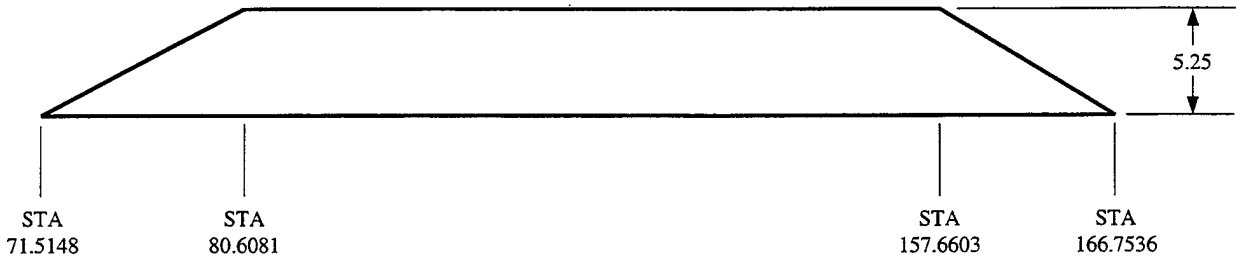


FIGURE 62. MODIFIED FIN FOR EXAMPLE CASE

PARAMETER	ORIGINAL FIN	NEW FIN
SURFACE AREA (1 FIN)	452.26410	452.26407
SEMISPAN	5.25000	5.25000
ASPECT RATIO	0.12189	0.12189
DISTANCE FROM NOSE TIP TO FIN AREA CENTROID	119.13422	119.13422
LEADING EDGE LOCATION	61.70000	71.51482
ROOT CHORD		95.23881
TIP CHORD		77.05228
TAPER RATIO		0.80904
LEADING EDGE SWEEP		60.00000
TRAILING EDGE SWEEP		-60.00000

FIGURE 63. OUTPUT FILE FOR EXAMPLE CASE

4.6 SYMBOLS

AR	Aspect Ratio
A_{seg}	Area of individual wing segment
A_w	Total planform area of wing (1 panel)
b	Span of wing (2 panels)
C_r	Root chord
C_t	Tip chord
$\overline{C}_{new}$	Area centroid of modified fin
$\overline{C}_{old}$	Area centroid of unmodified fin
$\overline{C}_{seg}$	Area centroid of individual wing segment
$\overline{C}_w$	Area centroid of wing planform
NPTS	Number of points defining wing shape
STA	Station: Axial distance from nose tip
$X_{L.E._{new}}$	Axial distance from nose tip to modified fin
$X_{L.E._{old}}$	Axial distance from nose tip to unmodified fin
XB(I)	X coordinate of I'th point on body
XF(I)	X coordinate of I'th point on unmodified fin
$XF_{new}(I)$	X coordinate of I'th point on modified fin
YB(I)	Y coordinate of I'th point on body
YF(I)	Y coordinate of I'th point on unmodified fin
$YF_{new}(I)$	Y coordinate of I'th point on modified fin
γ	Modified fin trailing edge sweep complementary angle
θ	Modified fin leading edge sweep angle complementary angle
λ	Taper ratio
$\lambda_{L.E.}$	Leading edge sweep angle
$\lambda_{T.E.}$	Trailing edge sweep angle

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